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LUMBAR PUNCTURE AND MENINGITIS.[1]

THE PART PLAYED BY LUMBAR PUNCTURE IN PRECIPITATING MENINGITIS IN ANIMALS RENDERED ARTIFICIALLY SEPTICÆMIC AND A PLEA FOR THE CONSERVATIVE USE OF DIAGNOSTIC LUMBAR PUNCTURE.

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Introductory.

The experimental study here presented is the outcome of reflections on the observations of the Rockefeller workers in regard to poliomyelitis and of discussions thereon with various members of the staff of the Children's Hospital, Melbourne.

It has been demonstrated by Flexner and Amoss (1) that, whereas it is difficult to induce experimental poliomyelitis in monkeys by the intravenous injection of virus, the characteristic symptoms and lesions appear with comparative ease when the intravenous inoculation is combined with an apparently trivial experimental disturbance of the meninges. The question thus arises, whether interference with the conditions normally obtaining in the cerebro-spinal space, *e.g.*, by lumbar puncture, might not facilitate, or even determine, the localization in the meninges of other organisms present in the circulating blood. Such a question assumes very great practical import in the presence of a systemic infection with an organism of known high pathogenicity for the meninges.

After I had conducted some initial experiments on cats in connexion with this work and while awaiting the arrival of monkeys, I learned of a similar investigation by Weed, Wegeforth, Ayer and Felton (2); although I was unable to avoid a knowledge of the general conclusions of these authors, I have refrained from reading their article and am unacquainted with the details of their experiments. This communication, therefore, is an account of an independent investigation, conducted with no knowledge of the experimental methods of the workers named.

Basis of the Present Study.

In order to set out clearly the manner in which withdrawal of cerebro-spinal fluid may operate to promote infection of the meninges under favourable circumstances, a brief review of some fundamental physiological facts is necessary.

The cerebro-spinal fluid is formed from the blood by the active secretion of the epithelial cells covering the choroid plexus. Its origin in a true secretory process on the part of the choroid body has been demonstrated by Dixon and Halliburton (3). These observers showed that, while certain factors, notably asphyxia and the influence of the volatile anæsthetics, induced a more rapid rate of flow of cerebro-spinal fluid, the most powerful stimulus to increased formation of this fluid was provided by injection of an extract of the choroid body. In its susceptibility to hormonic influence, therefore, the "choroid gland," as it was described by Mott, exhibits qualities which place it on a par with the other secreting glands of the body.

Diffusable substances introduced into the cerebro-spinal fluid, such as adrenalin, nicotine, atropine, reach the blood stream within a few seconds, as is manifest from the evidence of the typical physiological action of these drugs. The converse, however, diffusion from the blood stream to the cerebro-spinal fluid, does not occur (4) and it was upon this fact that Swift and Ellis based the now familiar procedure of subthecal injection of salvarsanized serum in cerebro-spinal syphilis, in an endeavour to obtain contact between the salvarsan and the treponemata in the recesses of the central nervous system. Barium chloride is such a violent poison to the central nervous tissues that the injection of 0.1 mgm. into the cerebro-spinal space rapidly kills a rabbit of two kilograms body weight, whereas 1,000 times as much of the drug is required to produce the lethal effect when given subcutaneously.

The explanation of the non-appearance in the cerebro-spinal fluid of drugs, poisons and the like when these substances are introduced into the blood stream, is to be found in the discriminative function of the choroid plexus. While providing and maintaining in uniform composition a fluid adapted to the special nutritive needs of the central nervous tissues, the choroid body stands sentinel over the subarachnoid space and prevents the access to the cerebro-spinal fluid of substances harmful to the delicate structures of the central nervous system. Indeed, the whole lining membrane of the cerebro-spinal space appears to co-operate with the choroid plexus in maintaining the "meningo-choroidal defence" (Flexner) (1).

The meningo-choroidal protective function was demonstrated by Flexner and Amoss (1) in a series of experiments to which reference was made at the outset of this article. Working with a poliomyelitic virus of which 500 c.cm. were necessary to produce lesions in a monkey when given intravenously, these observers found that if the injection into a vein were combined with lumbar puncture and the subthecal injection of normal horse serum, an intravenous injection of $\frac{1}{10}$ the amount (50 c.cm.) of virus sufficed to induce poliomyelitis in a monkey of the same weight. Further, the intrathecal injection of normal monkey serum, saline solution and even such physiologically balanced fluids as Ringer's and Locke's solutions, operated in a similar manner to promote localization in the central nervous system of the poliomyelitic virus introduced into the blood stream.

The removal of cerebro-spinal fluid from one monkey and its replacement by that of another monkey, sometimes, but not invariably, promoted infection, but simple lumbar puncture, in the absence of trauma as evidenced by blood in the fluid, was found not to precipitate the infection of the central nervous system.

[1] Read in abstract at a meeting of the Victorian Branch of the British Medical Association on September , 1920.

In the case of the intrathecal injection of a foreign protein, such as horse serum, a consequent simple, irritative, aseptic meningitis can be readily understood and the experiments showed that this mild disturbance of the meninges was sufficient to disorganize the meningo-choroidal defensive mechanism to such a degree that infection of the central nervous tissues by intravenous injection of the virus was greatly facilitated. But that what one would conceive to be the infinitesimal pathological changes following the introduction of Ringer's solution and normal monkey cerebro-spinal fluid should similarly undermine the meningo-choroidal protective complex, serves to emphasize the extremely delicate nature of this system and its capacity for very fine adjustment.

The foregoing supplies the rationale for the present series of experiments, the object of which was to investigate the possibility of lumbar puncture precipitating a meningitis in an animal rendered septicæmic with an organism of known pathogenic properties for the meninges.

Choice of Organism.

In the selection of the organism with which to conduct experimental work, I was guided by the frequent occurrence of pneumococcal meningitis in children as evidence of the high pathogenicity of the pneumococcus for the meninges and also by the fact that in the large majority of instances the localization of the pneumococcus in the meninges is but the end incident of a hæmic infection. Further, the notorious simulation of meningitis by children with pneumonia renders this condition pre-eminently one in which a diagnostic lumbar puncture is often performed.

In the course of six years at the Children's Hospital, Melbourne, I have been brought in contact with 58 cases of pneumococcal meningitis, in two of which the patients recovered, and in 56 the subjects came under *post mortem* investigation. The *post mortem* records show that in 28 of the fatal cases, meningitis arose during the course of a clinical pneumonia, in 11 it was associated with otitis or mastoiditis as the only other apparent lesion, in six it was one phase of a gross and obvious septicæmic process and in 11 the meningitis was a quasi-primary process, *i.e.*, no other discoverable focus of pneumococcus infection was present.

By what path does the pneumococcus reach the meninges in those instances in which the primary focus is situated remotely, *i.e.*, in the lung, and in the type of case in which there appears no other lesion to which the meningitis might be referred as secondary?

There is, of course, the possibility that in both groups virulent pneumococci gain access to the nasopharyngeal mucosa and thence take the direct path to the subarachnoid space, along the olfactory filaments. But it would seem to be established beyond question that pneumococcus infection is primarily a bacteriæmia, and that the pneumonia, for instance, is merely the expression of the secondary localization of the primary systemic infection.

Direct evidence supporting this conception of pneumococcus infection is afforded by very extensive bacteriological observations, undertaken to determine the bacterial condition of the blood, during life. Rosenow (5) obtained uniformly successful results in 77 cases, as did Prochaska (5) in 50 and Philosoffef-Weber (5) in 56 hæmo-cultures, which is to mention but a few of the numerous investigators who have demonstrated the essentially hæmic nature of the infection in pneumonia.

Indirect evidence is supplied by the frequency and variety of the complications that may ensue in the course of pneumonia, *e.g.*, meningitis, peritonitis, arthritis, and by the fact that any or all of these may occur without any pneumonic process.

The practical importance of an inquiry into the possible ill effects of lumbar puncture in children with pneumonia, lies in the well-known appearance of meningitis, often presented by such children when no such complication is present. Cerebral symptoms may predominate, such as headache, drowsiness, delirium, and may be associated with vomiting and constipation; *otitis media*, commonly present in pneumonia, as in other infectious disorders of childhood, may lead to retraction of the head. In conjunction with these features, the physical signs of a local process in the lung may be altogether wanting; it is within the experience of most clinicians to have seen the crisis occur in typical fashion, without the "patch" having been located.

That curious paradox, "meningism," in which spinal puncture discloses a clear fluid, with no cell reaction or bacterial content, is prone to occur in any acute infective process in children and particularly in pneumonia. But cerebral irritation does not necessarily mean bacterial invasion of the cerebro-spinal space and what clinician would undertake to predict unerringly a cloudy fluid?

Suggestive Clinical Data.

It may be permissible at this stage to quote a few suggestive experiences in routine clinico-pathological work. Of the 58 cases of pneumococcal meningitis to which reference has been made 52 yielded frankly purulent fluid at the first puncture and 6 disclosed a clear fluid which subsequently became cloudy, with pus and organisms. The brief notes below are copied from the case records and are necessarily condensed to the minimum, which will convey an idea of the clinical condition prompting the lumbar puncture. These cases are quoted as being merely suggestive of the relationship between the withdrawal of spinal fluid and the subsequent meningitis and are not advanced as furnishing proof of cause and effect. The sequence of events, however, is such as to call for an investigation, which this paper is an attempt to provide.

L.W., *æt.* 4½. Illness commenced two days prior to admission on December 30, 1916, with feverishness and delirium. Vomited later. Frontal headache. Lumbar puncture performed in out-patient department December 29, 1916. Clear fluid; increased pressure.

Laboratory report on cerebro-spinal fluid: A clear fluid, with no excess of cells and no demonstrable organisms.

In the physical examination on December 30 is noted diminished vesicular murmur over right chest posteriorly; some stiffness of neck; Kernig's sign present.

January 1, 1917.—Patient convulsed. Spinal puncture again performed; clear fluid, with no increase of pressure.

Laboratory report on second sample of fluid; A few red blood cells microscopically; leucocytes not in excess. No organisms observed in smear preparation; ascitic agar culture sterile.

January 2, 1917.—Improved.

January 3, 1917.—Twitching. Lumbar puncture: cloudy fluid. This specimen of fluid was found to contain numerous pus cells and yielded a culture of pneumococcus.

January 8, 1917.—*Post mortem* examination. Purulent meningitis of pneumococcal origin; (?) focus.

V.R., *æt.* 6 months. Admitted January 2, 1917. Pertussis for past five weeks; motions now green; constant twitching of hands. Temperature, 38.5° C.. Examination of throat, chest and abdomen negative. No stiff neck; fontanelle depressed; slight Kernig's sign.

Lumbar puncture, January 3: Blood-stained fluid.

Report on cerebro-spinal fluid: The specimen shows many red blood cells; in a film stained by Leishman's method there does not appear to be any leucocytic reaction; no organisms observed; culture sterile.

January 4.—Second spinal puncture: Fluid showed numerous pus cell and pneumococci.

Post mortem examination.—Broncho-pneumonia; pneumococcal meningitis (middle ears clean).

M.E., *æt.* 10 months. Admitted March 26, 1917. Diarrhœa of four days' duration; some vomiting; very drowsy; pale, dehydrated; fontanelle depressed; chest, abdomen and limbs clear.

March 29, 1917.—Vomiting a great deal.

March 31.—Lumbar puncture: clear fluid. Laboratory report: Routine examination showed no evidence of meningitis.

April 1.—Improved.

April 2.—Worse; "meningeal cry"; limbs stiff; no stiff neck; crepitations at both bases.

April 3.—Lumbar puncture: turbid fluid. Laboratory report: Fluid shows a marked polynucleosis and many large, mono-nuclear leucocytes. No organisms recovered.

April 8.—Improving till yesterday; since then crying a great deal; very stiff; rigidity of neck; pneumonic signs at left base.

April 10.—*Post-mortem* examination. Broncho-pneumonia. Pneumococcal meningitis (middle ears clean).

Unfortunately, it is not possible to adduce blood cultures in the foregoing cases, but in the following case lumbar puncture is shown to have been performed during a bacillæmia. It is to be noted that this child furnished the only example of typhoid meningitis among 106 cases of typhoid fever at the Children's Hospital during the last five years.

K.B., *æt.* 7, was admitted to the hospital on November 29, 1915. The clinical record describes his condition at that time as one of great restlessness and delirium. The boy was very tremulous; there was no head retraction and no cervical rigidity, but a "fairly well marked Kernig's sign" was present.

On November 30 spinal puncture was performed and an occasional red blood cell was the only pathological feature of the fluid.

Again, on December 4, the theca was tapped and no evidence of inflammatory changes could be detected in the fluid; it was sterile in culture. On the same day, December 4, the Widal reaction was found to be positive and on December 7 *B. typhosus* was cultivated by hæmo-culture.

My notes of this culture are recorded in detail and state that the organism was agglutinated by a 1:500 dilution of the serum of another enteric patient in the ward at the time. On December 9, cloudy fluid was withdrawn from the spinal canal; it was very purulent and exhibited numerous Gram-negative bacilli, which flourished as non-fermenters of lactose on MacConkey plates.

During the course of the experimental work, which it is the main purpose of this article to present, my attention was drawn to a communication from Wegeforth and Latham (6) in which was reported a clinical inquiry into lumbar puncture as a factor in the production of meningitis. These authors so planned their work that in every case of suspected meningitis in which lumbar puncture was performed, blood culture was carried out at the same time, or within a few hours. Altogether 93 patients were subjected to lumbar puncture on account of various indications of meningitis and of the total, 38 yielded purulent fluids at the first exploration.

There thus remained 55 in which the cerebro-spinal fluid was clear at the first withdrawal and in six of these patients the synchronous blood culture demonstrated a septicæmic state. Three of the hæmocultures were meningococcal and three pneumococcal; five of the six septicæmic patients with initially clear cerebro-spinal fluid subsequently developed purulent meningitis, one case of pneumococcal septicæmia going on to recovery.

Experimental.

As already mentioned, preliminary experiments (five) were conducted on cats, only to show that these animals were too resistant for any reliable conclusions to be drawn; the high degree of natural immunity to pneumococcus infection displayed by the dog rendered the outlook for satisfactory results with dogs very unpromising, as conversely did the great susceptibility of rabbits, in which a rapid septicæmie death was feared.

From the points of view of convenient size, ease with which spinal puncture might be performed and the close approximation of the general arrangement of the nervous system to that in the human species, monkeys were the animals of choice, although their behaviour with respect to pneumococcus infection, was, as far as I was concerned, a matter to be determined.

The introduction of pneumococci directly into the circulation, was effected by injecting the superficial artery, or one of its *venæ comites*, which is found on the inner side of the lower limb in monkeys, where its course in the leg corresponds to that of the internal saphenous vein in the human subject. The artery of the opposite limb was utilized for hæmo-culture, to carry out which the vessel was partly divided; the resulting spurts of blood were directed into a flask of ascitic broth. Throughout the series very little trouble was experienced from contamination of blood cultures.

Spinal puncture, unless otherwise stated in the protocols, was performed in the lumbar region and, as a rule, offered no difficulty when the animal's back was well arched by an assistant.

With the exception of the four animals included in the "passage" series, primary cultures of pneumococcus were used throughout, in order to obviate, as far as possible, the rapid attenuation of virulence characteristic of this organism. The criteria required to establish the identity of an organism proposed for use as a pneumococcus were:—

(*i.*) Its source, generally empyema pus from a child.

(*ii.*) That it should be a Gram-positive diplococcus, encapsulated in direct smears of pus, with tendency to chain formation.

(*iii.*) That it should produce acid in lactose, saccharose, raffinose and inulin-ascitic-peptone water.
(*iv.*) That it should be bile-soluble.

Preliminary Experiment.

MONKEY No. 1.—*Macacus rhesus.*

Experiment to determine the pathogenic property of pneumococcus for the meninges of the monkey and the nature of the reaction induced.

October 18, 1919.—Animal's initial temperature, 38.3° C.; 1.5 c.cm. clear fluid withdrawn from the spinal canal in the interscapular region and 1 c.cm. of a saline emulsion, containing 100 × 10^6 pneumococci injected intrathecally. The emulsion was prepared from an ascitic agar primary culture of empyema pus.

October 19, 1919.—10 a.m.: Sits with head thrown back; eyes semi-closed; moves stiffly. 5 p.m.: Head retraction marked; no food all day; supports himself on wires of cage; moves stiffly in response to stimulation.

October 20, 1919.—9.30 a.m.: Condition much the same; still no food. 11.30 a.m.: Anæsthetized. Temperature, 37.3° C.. Lumbar puncture: 0.75 c.cm. fluid, faintly turbid when viewed alongside distilled water. Fluid, upon examination, showed a definite polynucleosis, with red blood cells. Of 200 cells, 96 were leucocytes and 104 were red cells. Gram-positive, encapsulated diplococci were abundant in a stained film. Fluid cultivated.

October 21, 1919.—Cultures from spinal puncture fluid of previous day confirmatory of pneumococcus. Animal extremely drowsy; exhibits photophobia.

October 22, 1919.—Monkey lying on floor with head retracted; obviously moribund; killed by chloroform.

Post mortem examination.—An intense hæmorrhagic inflammation was present over the whole of the spinal cord, base of brain and cerebellum. The convexity of the cerebral hemispheres, although presenting a hyperæmic appearance, did not show the submeningeal extravasations of blood, which were the feature of the cord, base of brain and cerebellum and which produced a vivid mottling of the surface of these structures.

Cerebro-spinal fluid, collected from beneath the base of the brain, immediately the skull was opened, was blood-tinged. An estimation of the cells present showed that there were 33,000 red corpuscles to the c.mm. and 5,800 leucocytes, *i.e.*, the ratio of whites to reds in the cerebro-spinal fluid was as 1; 5.7. There was thus afforded evidence of an acute inflammatory process and although there was no visible purulent exudate, the fluid as viewed microscopically could be described only as sanguino-purulent. Gram-positive, encapsulated diplococci were numerous and cultures obtained from this fluid conformed to pneumococcus.

In this animal, therefore, subthecal injection of virulent pneumococci led to a hæmorrhagic inflammation of the meninges which virtually killed the monkey in 96 hours. It is to be regretted that a blood culture was not secured in order to investigate the likelihood of systemic infection through the conveyance of pneumococci by the cerebro-spinal fluid into its chief channel of exit from the cranial cavity, *viz.*, the venous sinuses of the skull.

It might be mentioned at this juncture that when meningitis supervened in later experiments, it was invariably of a sanguino-purulent type, in which the hæmorrhage, though the leading feature macroscopically, was found on microscopic examination to be accompanied by a very decided leucocytic reaction.

First or "Passage" Series.

MONKEY No. 2.—*Macacus rhesus.* Initial temperature, 37° C..

November 25, 1919.—Intravenous injection of 200 × 10^6 pneumococci, emulsified in saline solution from primary ascitic agar cultures of empyema pus.

November 26, 1919.—10 a.m.: Temperature, 39.3° C.; animal fairly bright. 4 p.m.: Temperature, 39.3° C. Spinal puncture: 3 c.cm. perfectly clear fluid, which, on microscopic examination, exhibited no cells or organisms and was sterile in culture.

November 27, 1919.—11 a.m.: Temperature, 40° C.. Respiration rate, 60 per minute. Animal very quiet and looks ill. Spinal puncture: 7 c.cm. slightly blood-tinged fluid, in which was noted a definite leucocytosis. This, however, was accepted with reserve as evidence of meningitis, on account of the presence of blood and the extreme likelihood of a systemic leucocytosis. Gram-stained smears showed no organisms and no growth developed when this fluid was sown on ascitic agar. A film of the peripheral blood, stained by Leishman's method, showed the presence, in small number, of encapsulated diplococci.

November 28, 1919.—Temperature, 40.9° C.; respiration rate, 68. Blood culture taken into ascitic broth.

November 29, 1919.—Temperature, 39° C.; respiration rate, 36. Animal very sluggish and not eating. Blood culture: Typical lanceolate diplococci—Gram-positive—chiefly in short chains. Solid medium (ascitic agar) sub-cultures were characteristic of pneumococcus, as were the sugar reactions and the bile solubility.

The animal was returned to its cage after just sufficient chloroform to permit of a reading of its temperature and at that time was breathing well and gave no indication of impending death. Half an hour later it was found dead.

Post mortem examination was carried out immediately. Small, sub-pleural extravasations of blood and a certain "stickiness" of the pleura were noted. Irregularly distributed patches of congestion appeared in both lungs, but these were air-containing and not consolidated. A diffluent condition of the splenic pulp was the only feature of note in the abdomen.

Central Nervous System.—The lepto-meninges were pallid throughout; a small, extra-dural extravasation was present at the site of the spinal punctures. The appearances in no way resembled or suggested the inflammatory changes described in the meninges of Monkey No. 1.

Summary.—Septicæmia induced, with marked general reaction and positive blood culture. Lumbar puncture performed twice during septicæmia. No meningitis.

MONKEY No. 3.—*Macacus rhesus.* Initial temperature, 37.3° C..

November 30, 1919.—Intravenous inoculation of 100 × 10^6 pneumococci. The culture used was that recovered from the blood of Monkey No. 2; as the primary ascitic broth blood culture from this monkey was transferred to ascitic agar for the purpose of making the saline emulsion, Animal No. 3 received pneumococci of the second generation in artificial medium. Lumbar puncture, performed at the same time as the inoculation was given, yielded 1 c.cm. of perfectly clear fluid.

December 1, 1919.—Temperature, 39.9° C.; respiration, 48; animal very sluggish and not eating. Spinal puncture: very slow drip; 1 c.cm. clear fluid obtained after draining the theca for thirty minutes. Cerebro-spinal fluid: No organisms in stained film; sterile in culture.

December 2, 1919.—Temperature, 39.9° C.; blood culture in ascitic broth; no spinal puncture.

December 3, 1919.—Temperature, 39.5° C.; animal bright and taking food. Lumbar puncture: very slow drip; 1 c.cm. clear fluid obtained. Aspirated finally, after draining for thirty minutes. Cerebro-spinal fluid: no leucocytic reaction; no organisms demonstrable. Blood culture of previous day: Abundant growth in ascitic broth of a Gram-positive diplococcus in pure culture. Transferred to ascitic agar, this coccus answered all the criteria above indicated as essential for the identification of the pneumococcus.

December 4, 1919.—Temperature, 39.9° C.; animal apparently well.

December 5, 1919.—Animal eating well and seemed bright; temperature reading not taken; no further lumbar puncture.

No further observations were made on this monkey, which made an uneventful recovery.

Summary.—Induction of septicæmia; spinal puncture on three ocasions, on two of which the theca was drained for 30 minutes. No meningitis, as judged clinically and by observations of the cerebro-spinal fluid.

MONKEY No. 4.—*Macacus rhesus.* Initial temperature 36.6° C..

December 4, 1919.—5 p.m.: Intravenous injection of 200 × 10^6 pneumococci; saline emulsion of second generation of

pneumococcus cultivated from the blood of animal No. 3.

December 5, 1919.—3 p.m.: Temperature 39.5° C.; animal very torpid; not eating. Spinal puncture: 2 c.cm. clear fluid; theca drained for 30 minutes and finally aspirated. The fluid showed no cellular increase and was sterile by culture. December 6, 1919.—11.30 a.m.: Temperature 38.8° C.; animal languid, but can be stimulated to jump. Blood culture taken in ascitic broth. Blood film: no organisms observed. Spinal puncture: 1.5 c.cm. clear fluid; theca drained for 30 minutes. This sample of fluid showed no increase in cell content and yielded no growth in attempts at culture.

December 7, 1919.—10 a.m.: Animal very languid; (?) head retraction; lying on side. Blood culture: copious growth of chain forming, pointed diplococcus, which subsequently answered all the required tests for pneumococcus. Transferred to ascitic agar for inoculation of next animal.

December 8, 1919.—10 a.m.: Temperature 38.8° C.; animal apathetic, lying on side, grinding teeth; no head retraction. Lumbar puncture: 2 c.cm. fluid obtained, the first few drops of which were heavily contaminated with blood, but the latter half of which was quite clear to the naked eye. Microscopically this second portion showed a few red blood cells, but no apparent polynucleosis and no organisms. Cultures were sterile.

December 9, 1919.—Temperature 38.5° C. Animal lies on side, with head retracted; when induced to move, holds the neck stiffly. Lumbar puncture: Cerebro-spinal fluid contained red blood cells, in number 4,000 per c.mm., and leucocytes, 280 per c.mm., or a ratio of whites to reds of 1: 14.3. An estimation of leucocytes and red corpuscles in the systemic blood made at this time disclosed: whites 13,800, and reds 3,870,000, *i.e.*, a ratio of whites to reds of 1: 280. There was thus a pronounced leucocytic reaction in the cerebro-spinal space; this was accompanied by a Gram-positive diplococcus, visible in large numbers in smear preparations of the cerebro-spinal fluid. The organism cultivated in a manner typical of pneumococcus on ascitic agar, produced acid in lactose, saccharose, raffinose, inulin and was bile-soluble.

December 10, 1919.—11 a.m.: Animal extremely weak and ill. Cervical rigidity marked. Kernig's sign was elicited. Frequent twitchings of limbs and tail. A second blood culture taken. 4 p.m.: Extreme opisthotonous and general rigidity.

December 11, 1919.—Died during the night. Blood culture secured the day before death yielded a characteristic pneumococcus.

Post mortem examination: Hæmorrhagic meningitis, particularly well marked in cervical region. Intense injection of the whole pia-arachnoid; some turbid fluid at base of brain; coagulum on choroid plexus. Fluid collected in fine pipette from anterior horn of lateral ventricle.

The whole of the upper lobe of the left lung was consolidated and completely hepatized; otherwise no lesions were present in the thorax or abdomen.

Examination of ventricular fluid: Microscopically, crowded with pus cells; Gram-positive diplococci in a field of polynuclears.

Culture: Profuse growth of pneumococcus as identified by the routine specified.

Summary.—Persistent septicæmia; the first evidence of meningitis appeared in the spinal fluid obtained at the fourth puncture and it is to be noted that the immediately preceding puncture yielded the first specimen of fluid containing blood. Discussion on the interpretation of this observation is reserved till a later stage.

Monkey No. 5.—*Macacus rhesus.* Initial temperature 38.3° C..

December 12, 1919.—Intravenous injection of saline emulsion, prepared from an ascitic agar sub-culture of the blood culture from the last animal. Lumbar puncture, at the same operation, yielded 4 c.cm. of a clear fluid, containing on cells or organisms, by drop, smear or culture.

December 13, 1919.—Temperature 39.8° C.. Spinal puncture: 4 c.cm. after 30 minutes' drip. Cerebro-spinal fluid was found to contain a few red blood cells; no leucocytic reaction; no organisms in smear or culture.

December 14, 1919.—Temperature 39.6° C.. Animal bright. Spinal puncture: 3.5 c.cm.; fluid blood-tinged; negative in other respects. Blood culture taken into ascitic broth.

December 15, 1919.—Temperature 38.8° C.. Animal eating and fairly active. Blood culture contaminated. Spinal puncture: 4 c.cm. fluid, which on examination showed red blood cells only; no evidence of inflammatory changes obtained by the usual routine.

December 16, 1919.—Temperature 38.8° C. Animal does not look ill. Second attempt at blood culture (serum broth). No spinal puncture.

December 17, 1919.—Temperature 38.6° C.. Spinal puncture: 2 c.cm. clear fluid. The cerebro-spinal fluid was found to exhibit a slight excess of leucocytes, polymorpho-nuclear and mononuclear, in approximately equal proportions. The leucocytic reaction was so slight that it was not held to be of significance and it was considered that it was due to irritation of the meninges by repeated punctures, with introduction into the spinal canal of minimal amounts of blood. Blood culture, in the second instance, yielded the typical lanceolate diplococcus, which was transferred to ascitic agar and confirmed as pneumococcus in the routine manner. The animal was then dismissed from further observation, as it appeared well in spite of the fact that interference by spinal puncture had been carried to an extreme degree. One week later the monkey seemed none the worse for the various experimental procedures.

Summary.—Septicæmia induced; lumbar puncture on five occasions; no meningitis; recovery of animal.

On consideration of the experimental results thus far obtained, I was impressed with the fact that Monkey No. 4—the only animal among the four above submitted as fulfilling all the required conditions to succumb to meningitis—was, from the beginning, very much more ill than any of the other three.

It was therefore decided to increase the dose of intravenous pneumococci, in order to determine whether the probability of meningitis supervening on lumbar puncture was in any way dependent upon the severity of the septicæmia.

It will be observed that in Animals 2 to 5 inclusive, the successive inoculations constituted a passage of the same strain of pneumococcus through the series; the object of the passage was to secure enhanced virulence as the experiments progressed, although any access of virulence was possibly nullified to some extent by the fact that two generations in artificial media intervened between monkey and monkey. The subculture from the primary ascitic broth to the secondary ascitic agar was thought advisable, as I had not sufficient monkeys to warrant the risk from possible toxicity of the fluid culture medium.

Before carrying out the second series of experiments, with increased dosage, what might be described as intermediate animals were infected, in original dosage, with a pneumococcus which was first passed through the cerebro-spinal space of a macaque, in order to obtain any possible advantage from adaptation of the strain to the meninges.

Intermediate Animals.

Monkey No. 6.—*Macacus rhesus.*

March 23, 1920.—Cerebro-spinal fluid (1.5 c.cm.) withdrawn and 1 c.cm. saline emulsion of a primary ascitic agar culture of pneumococcus recovered from an acute arthritis in a child, injected intrathecally.

It is scarcely necessary to detail the clinical course of this animal; the progress of the experiment was identical with that described for Monkey No. 1 and death ensued in 96 hours.

The characteristic, intense hæmorrhagic inflammation was present throughout the meninges and cultures of pneumococcus were secured from the cerebral ventricle for injection into the next two animals intravenously.

MONKEY No. 7.—*Macacus rhesus.* Initial temperature, 37° C.. Experimental technique was as in former animals, but as blood cultures were sterile, one essential condition of the investigation, *i.e.*, the induction of a septicæmic state, was not fulfilled and the monkey therefore furnished no observations.

MONKEY No. 8.—*Macacus rhesus.* Initial temperature, 36.6° C..

March 26, 1920.—Intra-arterial inoculation of 200 × 10^6 pneumococci in saline emulsion and cultivated from the lateral ventricle of Monkey No. 6.

March 27, 1920.—Temperature, 38.8° C.; animal active. Spinal puncture: 2 c.cm. clear fluid; no cells; no organisms demonstrable in smear or culture.

March 28, 1920.—Temperature, 38.7° C.; general condition good; a film of blood showed no pneumococci.

March 29, 1920.—Temperature, 38.8° C.; animal seemed well. Blood culture taken (ascitic broth).

March 30, 1920.—Blood culture positive; Gram-positive lanceolate diplococcus in ascitic broth; much chain formation; transferred to ascitic agar and confirmed as pneumococcus by sugar tests (including inulin) and bile solubility.

March 31, 1920.—Temperature, 38.8° C.; spinal puncture: 3 c.cm. clear fluid, showing no cells microscopically and sterile in culture.

April 1, 1920.—Temperature, 38.7° C.; second blood-culture. Spinal puncture: 2 c.cm. fluid, slightly blood-tinged. Microscopically, a few red blood cells; no apparent excess of leucocytes; no organisms in smears; cultures sterile.

April 2, 1920.—Second blood culture: A Gram-positive, chain-forming diplococcus, which conformed to all the reactions laid down for pneumococcus.

April 3, 1920.—Temperature, 38.6° C. Spinal puncture: 1 c.cm. blood-tinged fluid, which, microscopically, showed no leucocytosis and no organisms; the fluid was sterile on attempts at culture.

At this stage the animal was left to recover and the experiment was recorded as negative in regard to the induction of meningitis by lumbar puncture in the presence of a septicæmia.

Second Series.

MONKEY No. 9.—*Macacus rhesus.* Initial temperature, 38.3° C..

May 4, 1920.—Intravenous inoculation of 400 × 10^6 pneumococci, in saline emulsion prepared from primary ascitic agar culture of pus from an empyema.

May 5, 1920.—Temperature, 38.8° C.. Purulent conjunctivitis following accidental chloroform burn. *S. aureus* cultivated subsequently from conjunctival pus. 11 a.m.: Spinal puncture: 2 c.cm. fluid; first part blood-tinged, latter half quite clear. Microscopical examination of second portion showed a few red cells, but no evident excess of leucocytes. A smear showed no organisms and cultures were sterile.

Blood film: A definite leucocytosis, plainly of a polymorpho-neutrophile nature, was present; pneumococci could not be demonstrated in the blood film.

At this time, 24 hours after inoculation, the animal was very listless, refused food and avoided the light, but the presence of the conjunctivitis confused the clinical appearance.

May 6, 1920.—11 a.m.: Temperature 39° C.. Eyes somewhat improved; general condition very bad. Blood culture taken; the animal's whole aspect after this procedure was extremely bad, and he died sometime after 6 p.m., *i.e.*, 30 (+) hours after the lumbar puncture.

May 7, 1920.—Blood culture of previous day yielded an apparently typical pneumococcus; Gram-positive, lanceolate, in short chains. Transferred to ascitic agar; this organism subsequently conformed to all the required reactions as regards acid production in the four sugars and solubility in bile.

Post mortem examination: Double empyema; thin, purulent fluid, later shown to contain abundant pneumococci. Purulent mediastinitis: Hæmorrhagic areas in lungs; yellow plastic exudate over spleen and liver. Smear from heart blood: Pneumococci present. Central nervous system: General hyperæmia very marked; no obvious purulent process; numerous sub-meningeal hæmorrhagic points. Cerebro-spinal fluid, in all instances slightly tinged with blood, was collected from (*i.*) the anterior horn of the lateral ventricle, (*ii.*) the base of the brain, (*iii.*) the lumbar portion of the spinal canal.

The fluids from all three sources showed pneumococci in smears and subsequently in cultures, but the first and third specimens exhibited a distinct difference in cell content. That from the ventricle showed numerous polymorpho-nuclear leucocytes in the field; that from the lumbar spine showed a leucocytosis, but of obviously less degree than was present in the ventricular fluid. The actual cell counts were:

(*i.*) Fluid from lateral ventricle, 2,150 leucocytes per c.mm.;

(*ii.*) Fluid from spinal canal, 650 leucocytes per c.mm.;

and in both these specimens of fluid the white cells greatly outnumbered the red.

Summary.—Severe septicæmia induced; one spinal puncture; death with meningitis 30 hours after lumbar puncture.

MONKEY No. 10.—Control animal. *Macacus rhesus.*

May 8, 1920.—12 noon: Intra-arterial inoculation of pneumococci; saline emulsion of first ascitic agar subculture from ante-mortem blood culture of previous monkey (No. 9). Dose: 400 × 10^6. Initial temperature 37° C..

May 9, 1920.—Temperature 38.3° C.; animal fairly bright.

May 10, 1920.—Temperature 38.8° C.; very listless; taking little food. Blood culture: ascitic broth. Film of blood examined for pneumococci with negative result.

May 11, 1920.—Blood culture apparently positive; abundant growth of typical Gram-positive diplococcus, with short chain formation. Transferred to ascitic agar. The monkey was very ill; crouched persistently; moved sluggishly; was not eating. 11 a.m.: Respiration rate 60 per minute. 4 p.m.: Respiration rate 68 per minute, with expiratory grunt.

May 12, 1920.—Blood culture showed a growth characteristic of pneumococcus on ascitic agar; subsequently found to produce acid in saccharose, lactose, raffinose and inulin. Animal very lethargic; eyes semi-closed; moved with great difficulty; prostrated after the least exertion. Temperature 38.3° C.; respirations 52. A film of blood showed an extreme polymorpho-leucocytosis, but no pneumococci. The animal, untroubled by any further observations, very gradually got well. For the 48 hours from May 10, 1920, to May 12, 1920, he was desperately ill and at times seemed moribund.

Summary.—Induction of severe septicæmia; no spinal puncture; eventual recovery.

MONKEY No. 11.—*Macacus rhesus.* Initial temperature 36.1° C..

May 16, 1920.—Intravenous injection—saline emulsion of pneumococci—from primary ascitic agar culture of empyæmia pus. Dose: 600 × 10^6.

May 17, 1920.—10 a.m.: Temperature 38.6° C.; animal fairly bright. 2 p.m.: Drowsy; listless; sat crouched in corner with head down. Spinal puncture: 3 c.cm. perfectly clear fluid, showing no cells or organisms by drop, smear or culture. Film of blood: No organisms found; polymorpho-nuclear leucocytosis. Leucocyte count; 15,000 per c.mm..

May 18, 1920.—Temperature 38.8° C.; generally sluggish; huddled in corner of cage; not eating. Blood culture taken into ascitic broth. Lumbar puncture: 1.5 c.cm. fluid, slightly blood-tinged; extremely slow drip. Cerebro-spinal fluid (0.5 c.cm.) allowed to drip from the lumbar puncture needle on to an ascitic agar slope, but no culture resulted. A drop preparation of the fluid showed red blood cells in small numbers; no organisms could be found in a stained smear.

May 19, 1920.—11 a.m.: Temperature 38.6° C.; very listless and apathetic. Blood culture showed a copious growth of Gram-positive, lanceolate diplococci, chiefly in short chains. 3 p.m.: Very ill; did not move when worried, but remained lying down. 4.30 p.m.: Emitted occasional sharp cries; at intervals convulsive twitchings passed over the muscles of the limbs and the animal carried its hand to its head. Died some time after 6 p.m..

The blood culture was investigated in the routine manner and was found to conform to all the reactions specified for pneumococcus at the outset of the experimental section of this article.

Post mortem examination: Hæmorrhagic inflammation over whole of cord, medulla and cerebellum—not very marked on cerebral cortex. Many extravasations under leptomeninges, the whole very red, with some sticky exudate. Microscopical examination of a scraping from the exudate

showed it to be sanguino-purulent. Fluid from cerebral ventricle very purulent, with 16,000 pus cells per c.mm..

Fluid from spinal canal (lumbar region) densely packed with pus cells—40,000 per c.mm.. Smears from both sources contained polymorpho-nuclear leucocytes in large number; organisms were not numerous, but encapsulated Gram-positive diplococci were present. Cultures: Ventricular fluid—medium growth of pneumococcus. Spinal fluid: Sparse growth of pneumococcus, with a few colonies of *S. albus*.

Careful examination was undertaken to show that the organisms recovered from the ventricle and spinal canal were actually pneumococci; both cultures gave the important reactions of inulin fermentation and bile solubility and also induced acid formation in lactose, saccharose and raffinose.

The only other changes observed at autopsy were some scattered hæmorrhages under the pleura and a hæmorrhagic patch in the lower lobe of the left lung. Pneumococci could not be demonstrated in a film of the heart blood; it seemed very probable that the animal would have recovered from the septicæmia in the absence of the localization in the meninges.

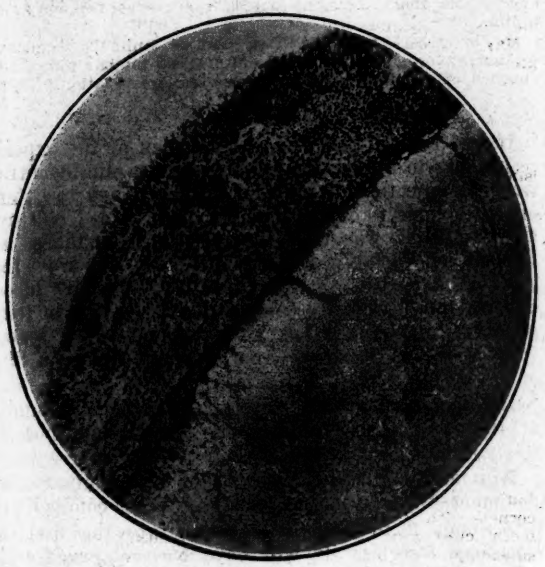

FIGURE I.
Meningitis following lumber puncture; inflammatory reaction in meninges. (Oc. No. 3. Obj. No. 3.)

MONKEY No. 12.—*Macacus rhesus*. Initial temperature 37° C..

June 8, 1920.—Intravenous inoculation of pneumococci, in saline emulsion prepared from a primary ascitic agar culture of empyema pus. Dose: 500 × 10^6.

June 9, 1920.—Temperature 38.2° C.; animal rather quiet, but not looking very ill. Lumbar puncture: 4 c.cm. of perfectly clear fluid; no cells; cultures sterile.

June 10, 1920.—Temperature 38.3° C.; animal rather quiet, but reacts to annoyance. Blood culture taken into ascitic broth. Lumbar puncture: Fluid seemed under increased pressure; rapid gush at first; 5 c.cm. collected. Examination showed a few red blood cells, with no apparent excess of leucocytes; stained smear devoid of organisms; cultures made.

June 11, 1920.—Temperature 38.4° C.. Blood culture: smears from ascitic broth show Gram-positive, lanceolate diplococci, some in short chains others "clumpy." The blood culture was transferred to ascitic agar and subsequently investigated along with the culture from the cerebro-spinal fluid of June 10, 1920. At the end of 24 hours there was no apparent growth of bacteria from the cerebro-spinal fluid. Spinal puncture: 4 c.cm. collected; definitely opalescent; microscopical examination showed the turbidity to be due, not to blood, but to polynuclear leucocytes. In the non-centrifuged specimen polymorpho-nuclear cells numbered 540 per c.mm..; the centrifuged specimen showed a small yellow ring of pus in the bottom of centrifuge tube. No organisms were detected in this deposit when stained; subsequently in culture a few colonies appeared of poorly staining diplococci, retaining the stain feebly after decolorization in the Gram method. Attempts to nurse them failed, but the work was conducted under difficulties at this stage by the fall in gas pressure owing to the strike of gas workers.

June 12, 1920.—The blood culture, transferred to ascitic agar, presented an appearance quite consistent with pneumococcus; small, slightly opaque, pin-head colonies. In smears the organisms comprising this culture tended to lose the stain of Gram's method and appeared morphologically as elongated diplococci with various involution forms. On this date a filmy growth was noted on the tube inoculated from the cerebro-spinal fluid of June 10, 1920, *i.e.*, of 48 hours' incubation. The smear preparation was identical with that described for the transferred blood culture. The

FIGURE II.
Meningitis following lumbar puncture; polymorpho-nuclear cell permeation of meninges. (Oc. No. 3. Obj. No. 7.)

cerebro-spinal fluid culture was afterwards brought on successfully and the cultures from the blood and cerebro-spinal fluid were examined in a series of parallel tests.

(*i.*) Both were identical in appearance in their growth on ascitic agar and in smear preparations.

(*ii.*) Both caused production of acid, without gas, in saccharose, raffinose and lactose in 24 hours.

(*iii.*) Both gave a delayed reaction in inulin-ascitic-peptone water, at three days a definite discharge of colour rather than the acid tint in the litmus.

(*iv.*) Both were soluble in bile.

The organisms recovered from the blood and cerebro-spinal fluid were therefore identical and the early involution of both cultures was no doubt connected with the low gas pressure, which was insufficient to maintain the incubator above 32° C..

Throughout the whole of June 12 the monkey remained in a corner of the cage, was very quiet, but exhibited no obvious meningeal signs. The temperature was 38.4° C.. It was subjected to no further interference and subsequently became well. On June 16, the temperature was 37° C. and the animal was remarkably bright.[1]

On June 16 blood was taken from the animal and the

[1] This monkey was rendered extremely ill with pneumococcus septicæmia, precisely one calendar month before it was used in Experiment 12, as a control to No. 9.

agglutinating powers of its serum with respect to pneumococcus were investigated. The bacterial emulsions were prepared from the cultures of pneumococcus isolated from the monkey's blood and cerebro-spinal fluid respectively. The agglutination results were found to run parallel in both pneumococcal suspensions, thereby supplying confirmatory evidence that the blood and cerebro-spinal fluid cultures were identical. In addition, an indication of a degree of immunity on the part of the animal was afforded by the following agglutination results:—

Pneumococcus.	Serum. 1:10	1:20	1:30	1:40	1:50
Blood..	++ ..	++ ..	+ ..	+ ..	±
Cerebro - Spinal Fluid	++ ..	++ ..	+ ..	+ ..	±

Summary.—Induction of pneumococcus septicæmia. Lumbar puncture: Pneumococcus cultivated from the cerebro-spinal fluid of the second puncture; evidence of meningitis, *i.e.*, cell reaction, in the fluid of the third puncture. Invasion of the cerebro-spinal space by pneumococci; subsequent recession of the process in an immunized animal.

Monkey No. 13.—*Macacus rhesus.* Initial temperature 37° C..

June 8, 1920.—Intravenous injection of the same pneumococcal emulsion as was given to the preceding monkey. Dose: 500×10^6.

June 9, 1920.—Temperature 38.6° C.; animal quieter than usual. Lumbar puncture: 4 c.cm. perfectly clear fluid, which was shown to contain no cells or organisms by routine examination.

June 10, 1920.—Temperature 39° C.; animal very excitable and irritable. Blood culture taken. Lumbar puncture: 3 c.cm. slightly blood-tinged fluid; smear and drop preparations showed no leucocytic excess; ascitic broth added to the centrifuged deposit did not develope any growth on incubation. Solid medium cultures also failed.

June 11, 1920.—Blood culture: Obvious contamination with staphylococcus. Blood culture repeated; temperature 39.3° C.. Lumbar puncture: 1 c.cm. blood-tinged fluid, in which no organisms could be demonstrated by smear or culture. On this date the animal was generally quiet, but extremely irritable when worried.

June 12, 1920.—Temperature 38.6° C.. No meningeal signs; animal on the whole better; no lumbar puncture. Blood culture of June 11, 1920: (*i.*) Direct smear from primary ascitic broth culture—Gram-positive cocci, in clumps and short chains; difficult to identify as between pneumococcus and staphylococcus. (*ii.*) Sub-cultures (*a*) colonies not discrete, (*b*) discrete colonies—some *S. albus*— others small, pin-head, semi-opaque. The latter were separated and grew well on ascitic agar, with the typical appearance of pneumococcus. The smear was that of a Gram-positive, pointed diplococcus and in the chosen sugars, including inulin, the organism produced acid change. It was also bile soluble.

Summary.—Induction of septicæmia. Lumbar puncture in the septicæmic state: No meningitis.

Monkey No. 14.—*Macacus rhesus.* Control animal. Temperature 36.1° C..

July 6, 1920.—Intravenous inoculation of pneumococci in saline emulsion, from primary ascitic agar culture of empyæma pus. Dose 500×10^6.

July 7, 1920.—Temperature 38.6° C.; animal fairly bright.

July 8, 1920.—Temperature 39° C.; monkey rather sluggish. Film of blood: No organisms demonstrable. Blood culture taken.

July 9, 1920.—Temperature 39.3° C.; no change in general condition; eating very little. Blood culture: Copious growth of Gram-positive, elongated diplococcus, with tendency to chain formation. Transferred to ascitic agar.

July 10, 1920.—10 a.m.: Temperature 39° C.; very quiet; not eating. 4 p.m.: Died.

Post mortem examination: No lesions observed in central nervous system; brain and spinal cord very pallid, in marked contrast to the nervous systems of Animals 9 and 11. Fluids collected from the base of the brain and spinal canal, although unavoidably blood-tinged, contained no organisms demonstrable in smears and were sterile on attempts at cultivation in fluid and solid media. In the thorax various hæmorrhagic points were noted under the pleura, but there were no pneumonic areas in the lungs. The spleen was turgid and very soft.

Monkey No. 15.—*Macacus rhesus.* Control animal.

July 6, 1920.—Intravenous injection from the same pneumococcal emulsion as was given No. 14. Dose: 500×10^6. Initial temperature 37° C..

July 7, 1920.—Temperature 38.3° C.; animal aparently well.

July 8, 1920.—Temperature 39.3° C.; very quiet; not eating. Blood culture.

July 9, 1920.—Blood culture apparently positive; copious growth of Gram-positive, pointed diplococcus, with much chain formation. Transferred to ascitic agar. The animal was then killed by chloroform at the stage corresponding to that in which cellular reaction appeared in the cerebro-spinal fluid of Monkey No. 12.

Post mortem examination: The brain and spinal cord were everywhere pallid and there was a complete absence of hyperæmia and hæmorrhage. No organisms could be cultivated from the cerebro-spinal fluid, nor could they be demonstrated in smear preparations.

The organism recovered from the blood during life was examined by the usual routine and was thus shown to be bile soluble and to ferment lactose, saccharose, raffinose and inulin.

Summary.—14 and 15: Two control animals, rendered septicæmic as shown by blood culture; no lumbar puncture; absence of meningitis on *post mortem* examination.

Commentary.

It will be seen that the general plan of the experiments was to render the animals septicæmic by intravascular injection of pneumococci and then to determine the success of the inoculation by blood culture. Hæmo-culture was performed in most instances at the end of 48 hours and in two cases was repeated and found positive on the sixth day. Positive blood culture was invariably coincident with a rise in temperature and a distinct polymorpho-nuclear leucocytosis, as was apparent from an inspection of a film of blood.

Lumbar puncture was carried out in some instances at the time of the intravenous inoculation, but in the majority of cases on the following day.

Animal No. 1 was the subject of a preliminary experiment, which does not call for further comment.

Animals 2 to 5 inclusive constitute the first or "passage" series. It will have been observed that only one of the four developed meningitis after lumbar puncture in the septicæmic state. Animal No. 6 was utilized for the passage of a strain of pneumococcus through the meninges of a monkey, in order to obtain the benefit of any enhanced virulence for the meninges that might accrue to this strain by "adaptation." The culture thus "adapted" to the meninges was injected into Animal No. 8 intra-arterially and lumbar puncture in the septicæmic state again yielded a negative result as regards meningitis.

In the second series invasion of the cerebro-spinal space by the organism shown to have been present in the circulating blood at the time, ensued in three out of the four animals subjected to lumbar puncture, whereas the pneumococcus could not be detected in the meninges or cerebro-spinal fluid of septicæmic control animals. As the animals of this series received double or treble the dose of pneumococcic employed in the first group and were obviously very much more ill in consequence, the inference was drawn that the probability of meningitis super-

vening on lumbar puncture was intimately related to the degree of septicæmia.

It is freely admitted that the degree of interference by lumbar puncture in the animals described was much greater than that represented by a single diagnostic puncture in clinical practice. But it was elected to perform repeated punctures by reason of two considerations, the first of which was that a daily examination of the cerebro-spinal fluid enabled me to keep a close watch on the course of events in the cerebro-spinal space, thereby reducing to a minimum the possibility of overlooking an evanescent meningitis; it was anticipated that such a transitory meningitis might reasonably occur and indeed this was the event in Animal No. 12.

The second consideration was that, in an endeavour to determine experimentally whether disturbance of the conditions normally obtaining in the cerebro-spinal space, provoked the appearance in the cerebro-spinal fluid of organisms circulating in the blood stream, it was quite legitimate to inflict a maximum of such disturbance to investigate the point.

If meningitis could be shown to supervene on two or three spinal punctures, it might very well happen that when conditions as regards virulence of the organism for the meninges and degree of septicæmia are favourable, it would follow one puncture. In this connexion attention might be drawn to Animal No. 9, in which one puncture was followed by meningitis and in which the septicæmic process was extremely severe.

It might be expected, on *a priori* grounds, that if lumbar puncture favoured the development of meningitis, the larger the amount of fluid withdrawn, the greater the probability of inducing meningitis. From a survey of the amounts of fluid withdrawn in the animals here reported, I am not able to contribute any data relative to this point, but the hypothesis seems so feasible that it is only a wise precaution, in performing diagnostic puncture in the presence of a probable blood infection, to withdraw, if the fluid be clear, just sufficient for laboratory examination.

A question that merits some discussion is the significence of blood in the fluid obtained by lumbar puncture. Occasional, even frequent, blood-stained fluids cannot be avoided, even by the most expert in lumbar puncture. The blood may appear as the result of injury to the extra-dural plexus of veins on the dorsal aspect of the dura, or it may be the evidence of more or less traumatism of the meninges. In the first contingency, especially, there would appear to be a very real risk of conveying infected systemic blood into the cerebro-spinal space, with the disastrous result of meningitis. All my observations went to show that this was the actual sequence of events in Animal No. 11. The hæmorrhagic meningitis was extreme in the lumbar region of the cord and the fluid taken from this source contained 40,000 pus cells per c.mm., as compared with 16,000 pus cells per c.mm. in the fluid from the base of the brain.

Again, if the introduction of mild irritants, such as horse serum, into the theca undermines the meningo-choroidal defence as shown by Flexner and Amoss (1), what is likely to be the effect of extravasation of blood within the dura?

Flexner and Amoss (1) demonstrated that simple lumbar puncture, if unattended by blood in the fluid, did not operate to induce localization of poliomyelitic virus in the central nervous tissues of monkeys infected intravenously, but when blood was withdrawn with the cerebro-spinal fluid, the results were the same as when the horse serum was injected.

Very recently I had exemplified the irritative effect on the meninges of the escape of blood intrathecally. An elderly man was suspected of meningitis, partly on account of convulsive seizures; spinal puncture was performed and the fluid obtained was heavily contaminated with blood. Another specimen was secured on the following day and showed a polynucleosis of 200 cells per c.mm.. I ventured the opinion that this leucocytic reaction was the result of the irritative action of blood, introduced within the theca at the first puncture; the patient subsequently developed a hemiplegia, with no accompanying meningitis.

Thus the performance of lumbar puncture too frequently (and unavoidably) resolves itself into withdrawal of fluid and introduction into the theca of blood, which is, in that situation, foreign protein. Lumbar puncture and injection of foreign protein constitute a combination of circumstances which has been shown by Austrian (7) to lead to meningitis in rabbits injected intravenously with meningococci.

Among the animals used in the present investigation, of those which developed meningitis Nos. 4 and 9 showed the process more advanced in the neighbourhood of the choroid plexus than in the spinal canal.

In No. 4 a coagulum of purulent exudate was attached to the choroid plexus and in No. 9 the number of pus cells in the cerebro-spinal fluid collected from the anterior horn of the lateral ventricle greatly out-numbered those in the fluid of the spinal canal. In No. 11, however, as already indicated, the infection appeared to have travelled in the reverse direction and to have been introduced by infected systemic blood.

Animal No. 12 is interesting as showing the possibility of the pneumococcus gaining access to the cerebro-spinal space, with the production of an evanescent meningitis in an immunized monkey.

It is submitted that the controls were effective. Animal No. 10 was rendered desperately ill; No. 14 died of the septicæmia without meningitis and No. 15 showed elevation of temperature, leucocytosis and positive blood culture. This animal was killed in order to examine the meninges at the stage corresponding to which the transient meningitis appeared in No. 12.

The results obtained by Austrian (7) in experimental meningococcus meningitis show that the intravenous injection of meningococci in normal rabbits is not followed by meningitis, unless local injury is produced and conditions are disturbed by the withdrawal of spinal fluid, with or without the sub-thecal injection of some bland irritant, such as horse serum.

Amoss and Eberson (8) were unable to produce meningococcus meningitis in monkeys and rabbits by intravenous injection of meningococci alone; meningitis due to the meningococcus followed, however,

when spinal puncture, combined with the sub-thecal introduction of a mild irritant was performed during the bacteriæmia.

The impairment of the meningo-choroidal defensive mechanism by spinal puncture and by the injection of horse serum within the theca is also illustrated by the experiments of Kolmer and Sekizuchi (9) and of Flexner and Amoss (10), which show that the procedure indicated facilitates the passage of antibodies from the blood to the cerebro-spinal fluid.

Idzumi (11), in a series of experiments upon rabbits and dogs, found that the intravenous injection of virulent pneumococci was never followed by the development of meningitis. This worker also investigated the effect of spinal puncture and injection into the theca of sterile serum or broth during the septicæmia and found that the net result might be expressed as usually acute meningeal congestion and occasionally suppurative lepto-meningitis.

In the present investigation, no intrathecal injections were made, as the work was undertaken to study the effect of simple lumbar puncture.

If the evidence herein submitted be accepted as establishing the risk of meningitis incidental to lumbar puncture in pneumococcus septicæmia, it is also applicable, with perhaps a greater degree of significance, to meningococcus infection, for in this condition there is involved an organism of pre-eminent predilection for the meninges. The opportunities for study afforded by the extensive, one might say pandemic, outbreak of this disease in the early years of the recent war, enabled bacteriologists to demonstrate conclusively the essentially hæmatogenous origin of meningococcus meningitis.

In 1909, Elser and Huntoon (12) adduced evidence in support of this conception, which is now generally accepted, whereas the original teaching of Flexner, that the infection of the meninges was by direct extension from the naso-pharyngeal mucosa, has gradually lost support.

Again, it cannot be too strongly emphasized that in meningococcus infection, meningitis is not inevitable. Loiseleur and Mongiol (13), Sainton and Maille (14) and Bovaird (15) report cases of meningococcus septicæmia established by blood culture—in one case (L. and M.) the meningococcus was cultivated from the blood as late as the nineteenth day of fever—in which meningitis did not supervene. I have a record of a *post mortem* examination of a child, in whom the condition could be described only as meningococcal pyæmia; miliary points of suppuration, due to the meningococcus, were present in the lungs, liver, kidneys and heart muscle, yet there was no meningitis.

If meningitis were the invariable outcome of meningococcus invasion of the blood stream, there would be no particular need to urge discrimination in the use of the diagnostic puncture, but the recognition of the fact that meningococcus infection does not necessarily spell meningitis involves the obligation to exercise caution in resorting to a procedure which may determine the ominous event.

The literature, admirably summarized by Wegeforth and Latham (6), contains numerous records of clear fluids obtained at the first and second punctures in meningococcus infection, with cloudiness of later specimens. Thus Sladen (16) in 1910, in reporting 23 cases of epidemic cerebro-spinal meningitis, calls attention "to the frequency with which the complete change in character of the spinal fluid has been noticed to follow lumbar puncture."

Foster (17), in emphasizing the need for bacteriological tests for accurate diagnosis, remarks that one may frequently obtain two or three perfectly clear samples of fluid before a specimen is obtained in which there occurs an abundant growth.

In the various explanations advanced to account for the initial clear fluid in meningococcus meningitis, the possibility that the withdrawal of fluid of itself may operate to determine meningitis does not appear. As far as I am aware, the work of Weed, Wegeforth, Ayer and Felton (2) was the first effort to study the effect of simple withdrawal of cerebro-spinal fluid from this point of view and my own experiments were under way when I became aware of this work.

Conclusion.

It remains to consider the application of the experimental results to clinical practice. In recapitulation of the findings, it might be stated that in the first series of animals, none of which was strikingly ill, one out of four developed meningitis, or one out of five if the "intermediate" animal be included. In the second series, in which the dosage was doubled and in some cases trebled, invasion of the cerebro-spinal space occurred in three out of four monkeys.

I feel warranted in urging that the lumbar puncture needle should not be employed, except in the presence of definite clinical signs of meningitis and in deprecating its use as a possible royal road to the diagnosis of an obscure condition.

Lumbar puncture in the presence of a septicæmia may operate in two ways to promote infection of the meninges: (*i.*) by impairing the integrity of the choroid plexus and meningeal lymphatics; (*ii.*) by extravasation of blood, which itself may be infective, within the cerebro-spinal space. Hæmorrhage within the *dura mater*, apart from infectivity, aggravates the effect of withdrawal of cerebro-spinal fluid, for it is the equivalent of the "bland irritant" introduced into the spinal canal in the work of the different experimenters quoted.

It is not suggested that spinal puncture, in the presence of a septicæmia, invariably leads to meningitis; but evidence is adduced to show that when conditions as regards severity of the septicæmia and pathogenicity of the causal organism for the meninges are favourable, there is a definite risk attached to the operation of lumbar puncture.

As regards pneumonia in children, the fact that the clinician maintains a constant look-out for complications, such as meningitis and arthritis, is a tacit recognition of the hæmic nature of the pneumococcus infection; unless the bacteriological condition of the blood has been carefully investigated, a measure possible as a routine only in hospital practice, lumbar puncture should not be lightly undertaken.

As long as the results of treatment of pneumococcal meningitis remain as disappointing as they are at present, the withdrawal of a cloudy fluid does nothing more than establish the diagnosis; there would be no objection whatever to the puncture if a purulent fluid

could be always foretold, but how often does it not materialize even when confidently anticipated!

Once the decision to perform lumbar puncture has been reached, it would seem wise, unless the fluid is definitely turbid, to take off just sufficient for laboratory examination.

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As on a former occasion, I am under very great obligation to Mr. D. Le Souef, Director, Zoological Gardens, Melbourne, for his generous assistance in the accommodation of the animals and for his valuable advice, of which it was frequently necessary to avail myself.

Dr. W. Atkinson Wood, on a recent trip to Java, went to much trouble to secure and supervise the transport of a number of monkeys and, in the absence of the animals obtained by Dr. Wood, the work could not have been carried to a stage at which conclusions could be drawn.

Much needed assistance was also forthcoming through the kind offices of Professor (then Dr.) J. Burton Cleland and of the Editor of *The Medical Journal of Australia.*

The Committee of Management of the Children's Hospital, Melbourne, have throughout afforded me every facility for the prosecution of the research.

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(14) Sainton and Maille: *Bull. et Mém. Soc. Méd. des Hôp. de Paris*, 1915, XXXIX., 296.

(15) Bovaird: *Arch. Int. Med.*, 1909, p. 267.

(16) Sladen: *Johns Hopkins Hosp. Rep.*, 1910, XV., 397.

(17) Foster: *Méd. Bull. de Paris*, 1918, I., 346.

Reviews.

AN ARTISTIC PRODUCTION.

Conrad Martens was born in London in 1801 and studied water-colour painting under Copley Fielding, to whose fame time has perhaps not been so kind as poor Fielding might have wished.[1] Martens for some unknown reason went to Monteo Video and there met a ship called the *Beagle*, by destiny to be immortal, for she carried, as a passenger round the world, one Charles Darwin of some little note. The young painter joined the ship for a time and gradually drifted to Sydney by way of Valparaiso, Tahiti and New Zealand, reaching Australia in 1835. Falling in love with the harbour he remained in Sydney till he died in 1875. He taught drawing to the daughters of the squattocracy and sketched every aspect of scenery that came within his vision. In 1863, as he could no longer make a living by his art and he felt old age coming on apace, he was appointed assistant parliamentary librarian and thus he laboured twelve years till laggard death finally knocked at the gates. In those times no one had invented bridge, the jazz or the cinema and people were driven to use their brains in order to get through the evenings; many developed hobbies; among these was Martens, who made amateur telescopes. The making of specula passed for him many a delightful leisure hour and, the telescopes completed, there was all the joy of looking at the infinite, the nebula in Orion, the rings of Saturn and endless other glories of the heavens. Not many are clever enough to make an astronomical telescope and not many clever enough to take joy in its use; and we may be sure that Martens, in his honest, thorough way, made the very best telescopes that an amateur could turn out. On Sundays, as in those days it was wicked to amuse oneself, he took round the plate at St. Thomas's, North Sydney; he paid his debts and was faithful to his troth. Altogether he was a simple, God-fearing, industrious, honest, apparently bourgeois person, who did his duty, but would never have been suspected of being a true poet. One must envisage the frowsy Sydney of the period, hot, isolated, quarrelsome, squalid, remote from every artistic impulse, as degraded a settling as could well be imagined for a man of genius. The wonder is that he ever succeeded in making a living at all; but the harbour was there, lovely and queenly with its great waters; it was for this that he lived. He was probably the first man really to see its glory, ever really to feel its marvellous charm, or at least to try and convey his impressions to the minds of his fellows.

Much of his work, most of it in fact, is purely topographical. The excellent sheep-breeders whose country houses he sketched, asked for nothing more than extreme accuracy of delineation. Probably they had no ideas on the subject of art and their ideal of beauty would no doubt be a prize ram; yet the poor piper had to play his tune to suit their paying. Consequently in much of his ordinary bread and butter work there is no particular beauty of conception beyond the natural beauty that lay in many of his subjects; but now and again one comes across a picture which fairly takes one's breath away. In the presence of perfect beauty one loses the power of adequate expression; one is, as it were, crushed by a joy that is akin to pain and something of this one feels when gazing on the harbour pictures of Conrad Martens. Here is beauty, here is romance, here is the light that never was on sea or land, all glowing with the poetry of a truly noble mind. How do the poets succeed in doing these things? Do they know what they are doing, or are they driven unconsciously forward by some power which has both the ability to compel their actions and to raise up men capable of understanding and appreciating them? We do not know. Aristotle tried to tell us twenty-three hundred years ago; he said that we cannot explain the fact; we can only accept it. And we also can only accept it and wonder. Martens showed, in some of his pictures, much of this power of masterly and romantic interpretation. It is to this that he owed a capacity to make his pictures, when he was given a fair chance, even more beautiful than their exquisite subjects. But, after all, what is beauty? Why should a picture by one man be a work of supreme joy, while a picture by another of precisely the same subject and technically as well executed be commonplace?

Mr. Lionel Lindsay, himself a fine artist and a sensitive critic, has done his part exceedingly well. Avoiding the incomprehensible jargon of the artist, he has explained his points in language that anybody can understand, which is more than can be said of most art critics. On the whole the views of the harbour are the finest and most people will probably agree with Mr. Lindsay that the "Sydney from Vaucluse" is the masterpiece. It is Sydney, not as she ever was or is, but as she ought to be; the transcendent Sydney of a gorgeous dream. True, Sydney has changed since those

[1] Conrad Martens: The Man and His Art, by Lionel Lindsay; 1920. Sydney: Angus & Robertson, Limited; Demy 4to., pp. 33, with 32 coloured plates, 12 sepia drawings, 16 pencil drawings and three illustrations in the text. Price, Two guineas.

days; she has in many ways grown less lovely; but go to Vaucluse and look upon the scene with what you may of Martens's vision and you will realize that the north-easter still flecks the great placid water; the vastness, the graceful hills and the illimitable fields of heaven are still there; and still the sun sets rosily behind fine weather clouds; putting aside as accidents the miles of red-roofed and fussy buildings you will see that in substance it is still the same harbour of Sydney as has always been so passionately adored and so ruthlessly scarred by her sons.

Some of the more imaginative scenes are exquisite. "Dawn" and "Moonlight" are especially noteworthy. As a draftsman Martens was superb and even the lowliest of his pencil drawings have much of that opalescent veil of romance which makes the difference between good and great art, that inexplicable difference which has been the object of so much passionate endeavour. To take an instance from literature, ponder upon the magical difference between the commonplace "splendid vision" and Wordsworth's "vision splendid." Wordsworth was sometimes an artist of absolutely supreme rank; it is to him, perhaps, that Martens may be best compared. Like Wordworth he was capable of flights into the empyrean of romance, and, again like Wordsworth, much of his work was of little imaginative interest. As an instance of his imaginative power, take his drawing of the Governor Bourke statue, which gives the old Governor as looking humbly, not arrogantly, over a scene of almost divine beauty, a scene which is rather indicated than drawn. It might so easily have been made merely topographic by a less poetic hand.

The reproduction and general get-up of the work are worthy of the highest praise and it is clear that in Messrs. Hartland and Hyde, who are responsible for the reproductions, we have in Sydney a firm which is capable of the highest flights in this particular kind of work. It is difficult sufficiently to praise the achievement of everyone concerned in the production of this book; it is not too much to say that it is one of the most beautiful things yet done in Australia and could be excelled nowhere in the world. The printing by Messrs. Penfold is particularly beautiful.

TROPICAL MEDICINE.

The well-known test book of Castellani and Chalmers has after an interval of six years appeared in a new edition.[1] The second edition was a stately volume, but the new edition contains an additional 600 pages, an increase which makes the new volume cumbersome to handle. A splitting up of the book in two volumes, the first dealing with the causation of the diseases and the second with the diseases of the tropics, would have been a great advantage.

The book itself is a veritable encyclopædia of tropical medicine and deals fully with practically every aspect of this important and complicated branch of medicine. A great deal of the criticism, levelled against the previous edition, still holds good. More fault can, perhaps, be found with the third than with the previous edition. A great many doctrines, hitherto not definitely proven, have been put forward as facts without further comment. Those whose work is carried out far away from a reference library, may experience difficulty in distinguishing the wheat from the chaff and may even be led astray.

Nearly half the book is devoted to animal and vegetable parasites and their life histories as far as they are known. Unfortunately in this part Castellani and Chalmers introduce in several chapters an entirely new nomenclature, which only tends to increase the confusion reigning amongst several of the genera. For example, the "*Trypanosominæ*" have been split up into several tribes and for *Trypanosoma gambiense* the name of *Castelanella castellani* has been coined by Chalmers. Apart from the fact that the use of a meaningless complex of syllables taken from a personal name for coining new generic names for parasites is objectionable, it seems of still greater disadvantage to rename a well known group of parasites; to form such a word as *Trypocastellanellæ* seems an etymological crime.

[1] Manual of Tropical Medicine, by Aldo Castellani, C.M.G., M.D., M.R.C.P., and Albert J. Chalmers, M.D., F.R.C.S., D.P.H., Third Edition; 1919. London: Baillière, Tindall & Cox; Demy 8vo., pp. 2,436, with 16 coloured plates and 190 illustrations in the text. Price, 45s. net.

Castellani's classification of the *Monilia* by their biochemical reactions cannot be generally accepted, since experience with different strains of moniliæ shows the fickleness of their chemical affinities and the same strain gives inconstant sugar reactions at various times.

Otherwise if a muster were held of tropical and other parasites, it would be found that only very few have been overlooked in the book, even those described once only on an odd occasion and not encountered since. It is certain that the first part of the book will form again an inexhaustible store house for the experienced parasitologist, although the neophyte will require especial care and guidance when moving amongst the maze of names and oddities.

The clinical part of the book has been brought up to date and several new chapters containing the experiences during the war, such as war zone fevers, have been added.

A useful innovation is the chapter on the diagnosis of a tropical fever, which will prove a great blessing to the tropical practitioner. A careful perusal of these pages will save many pitfalls in the realm of fevers in the tropics, which form so complicated a subject, because the practitioner does not always "think" of all the possibilities.

The treatment of the different tropical diseases has been well put forward, but, in quite a few instances, old methods, which have been proved inefficacious, have been given another few years of existence in print.

On the whole the new edition is a distinct advance when compared with the previous edition and will be a welcome companion to the experienced medical officer in the tropics. In a new edition, however, we would like to find a more critical perusal of the modern literature and not so many pages devoted to "hurried" discoveries, many of which die a natural death, but unfortunately not as quickly as they were born.

University Intelligence.

UNIVERSITY OF WESTERN AUSTRALIA.

At a meeting of the Senate of the University of Western Australia, held on October 9, 1920, the question of the increased salaries to be paid to the lecturers and assistant lecturers was discussed. It was proposed that the estimates should be referred to a joint committee of the General Purposes Committee and the Finance Committee and that the Committee be required to consider the whole question and to take into consideration a method suggested by the Professorial Board. The suggestion is that the increases should be calculated "as a percentage on the first £300 of the salary by reference to the average index number for the last twelve months and for the year preceding the year of appointment." It was estimated that if this suggestion were carried into effect and other increased expenditures were sanctioned, an additional sum of £2,500 would be required. The members of the Senate held very divergent views concerning the most expedient method of meeting the financial difficulty. The Chancellor objected to the proposal to borrow money from the bank. Another proposal to the effect that the work of the University should be curtailed sufficiently to bring down the expenditure to within the limits of the present income, apparently failed to secure support. It was eventually decided that the Premier should be approached on the subject.

THE MEDICAL ACT AMENDMENT ACT (TASMANIA).

It was announced in the Tasmanian Parliament on November 16, 1920, that the Royal assent had been given to the Bill to amend the Medical Act. This measure has been described by Mr. L. L. Dobson, one of the legal representatives of the Medical Council, as "an unspeakable measure which substitutes seven years' successful fraud for five years' medical instruction as a qualification for admission to practice as a physician and surgeon in Tasmania."

We regret to announce the death of Dr. G. H. S. Blackburne, of Albany, Western Australia, as the result of a motor-car accident.

The Medical Journal of Australia.

SATURDAY, NOVEMBER 27, 1920.

Paranoia and Occultism.

Although there is nothing new in spiritualism, nor in the hundred and one other forms of occultism, a highly susceptible world appears to be subjected at the present time to a series of attacks by the advocates of the mystic. Before the war the hysterical element of the daily press was probably too limited in its extent to scatter the seeds of these dangerous doctrines broadcast. No doubt, those responsible for the tenor of the daily sermons preached in the columns of our newspapers recognized that in the presence of commercial prosperity and the saner forms of government, men, and women too, had neither taste nor leisure for such vapourings. It did not pay to give prominence to the views of the so-called leaders of the world of mystics. The war has made a great difference. The untutored man is always prepared to "believe his senses." If he sees or hears anything strange, he is convinced of the reality of the thing seen or heard. Indeed, few people are willing to admit that they could be victims of delusions. The presence of death and of perpetual danger, unexpected happenings and uncanny environment are calculated to produce in the minds of all but the most stable a tendency to imagination and self-deception. The records of the battle-fields of France and Flanders contain much evidence of wide-spread delusions, born of superstition, fear and confusion. This preparation for the reception of suggested delusions was not limited to those who fought. Grief is the mother of distraction and the grand-parent of an unbalanced mind. Again, there is nothing new in this state of affairs. After every crisis in the world's history, the superstitions and delusions of the people have increased. It takes a long time for the world to refind its sanity.

If those whose experience of war had rendered them unusually vulnerable to psychic injuries and those whom grief has rendered ill defended, were left alone, the results would be short-lived and of small moment. Unfortunately, there are loud-tongued, persistent spiritualists and irrepressible crystal-gazers and faith-healers at all times ready to prey on the frailties and foibles of the weak. These men are often serious, honest and convinced victims of delusions themselves. Of course, there is a large class of miscreants, who trade consciously and fraudulently on the infirmities of human nature and who do not hesitate to employ tricks of every kind for personal gain. The law must be left to deal with this class. Every psychiatrist of experience can supply the records of paranoics with brilliant intellects, men suffering from systematized delusional insanity, whose views on the majority of subjects are deserving of the utmost consideration and respect. The psychiatrist often has the utmost difficulty in persuading both medical practitioners and laymen that some of the less usual forms of paranoia are in reality forms of insanity. It seems incredible that an otherwise intellectual man, who argues incorrectly on a single false premise, should be regarded as insane. Experience has proved that the nature of the false premise is of small importance; the determining factor is that the thing is a delusion, that the person is incapable of arguing rationally concerning the reality of the premise. No one has yet brought forward any evidence of the possibility of living people having communication with the dead. While the majority of people accept as part of their religious belief a future existence, a perfectly sound position to assume, it must be admitted that there is a great difference between belief and a fact capable of proof. The spiritualists endeavour to persuade us that they see and hear the wraiths of those who formerly lived. They would have us accept their delusions and thus destroy the essence of all religious creeds. In every mad-house there are patients who are just as convinced that they see people who do not exist and hear voices that arise in their disordered minds.

This matter would not be serious were it not for the fact that some eminent scientists and prominent men of letters are among those who have been deceived by insidious delusions of this kind. The arrant nonsense spoken of as "psychic research," "experimental investigation" and the like is liable to mislead a very hysterical and suggestible public. It

savours of scientific inquiry, while, in fact, it is merely the accentuation of the environment necessary for successful auto-suggestion. How much harm may be done by these earnest, but mistaken, persons is admirably described by Dr. William Young, in a lecture delivered at Vancouver, at the annual meeting of the Canadian Medical Association in June of this year. The article is reproduced in the *Journal of the American Medical Association* of September 18, 1920. We recommend this sane and excellent dissertation to our readers. Medical practitioners should do all they can to warn their suggestible patients against listening to the pernicious doctrines of the occultists. It may make all the difference.

INFECTIVE MENINGITIS.

In this week's issue we publish an article which should be read with great attention and deliberation by every medical practitioner in the Commonwealth. Dr. Reginald Webster not only demonstrates the necessity for caution in performing the apparently harmless operation of introducing a needle into the spinal canal, but incidentally leads us to consider whether we are justified in interfering with Nature unless some very urgent reason for the interference exists. Dr. Webster's carefully planned and well conducted experiments reveal the possibility of the artificial extension of a blood infection to the meninges. The organism possesses a complicated and usually strong barrier against the invasion of the cerebro-spinal organs. It has been suggested that lumbar puncture may create a disturbance in this defence and thus allow bacteria flourishing in the blood stream to gain access to the meninges. Dr. Webster demonstrates that this may actually occur, although it is by no means a necessary result of lumbar puncture. It seems that the damage done to the membranes may lower their resistance and that the bacteria in the blood may find their way past the natural barrier. It is also possible that blood containing bacteria may be carried into the spinal canal by the needle. Moreover, Dr. Stawell has suggested that the track of the needle may form a passage for the entry of bacteria from outside the theca. Even if the risk be remote, the warning given is justified. We should be ever alert to avoid doing harm in our endeavour to benefit our patients.

THE FLOCCULATION TEST IN SYPHILIS.

Notwithstanding the many criticisms levelled against the Wassermann test for syphilis, evidence has been collected in all parts of the world concerning its value as a diagnostic agent. The technique has undergone modifications and certain sources of error have been discovered. In the hands of an expert a diagnosis of syphilis can be made without hesitation if the serum in contact with certain lipoids is capable of preventing the occurrence of hæmolysis. The failure of the serum to prevent the hæmolysis may be regarded as excluding a syphilitic infection in the majority of cases. The test is not of value in the very early stages after exposure, under certain conditions when the infection has become latent and in a few cases with late manifestations. Many practitioners are disposed to place little reliance on reports of failure of the serum to react. This has arisen at times because those performing the tests have not employed standard methods or have been careless in permitting laboratory assistants to carry out the technical work. In other instances the unreliability of the results has been due to staleness of the test serum or to mistakes in its collection. Moreover, the clinician often expects to receive aid in diagnosis from the bacteriologist without supplying the latter with available information which may be of importance to him.

The Wassermann reaction is therefore a very important diagnostic measure. It has its limitations. In certain cases the response to the test is doubtful; in others it is negative, notwithstanding the clinical evidence of an infection. When Wassermann first described the test, he thought that he was dealing with an antigen-antibody reaction, deflecting complement from the hæmolytic system. As is well known it has been proved that the Wassermann reaction is not an instance of the Bordet-Gengou phenomenon. Many biologists have come to the conclusion that it is a specific inactivation of complement by a lipoidal substance in colloid condition associated with a syphilitic serum. It is further probable that the lipoid-antibody compound reacts with the globulin of the complement containing serum, effecting a change in its molecular arrangement. This altered globulin is deprived of complement action, although under certain conditions the original molecular state can be restored and the complement power revived. It was formerly held that complement was destroyed by heating the serum for one hour to 56° C.. It is now recognized that heating effects a molecular change; a reversion to the original constitution occurs after the lapse of time under favourable conditions and with this reversion complement action reappears.

The change of the globulin effected by the lipoid-syphilitic antibody couple is not unlike the phenomenon of removing complement action by a partial throwing out of solution of the globulin. This similarity of action led Professor H. Sachs and Dr. W. Georgi to ascertain experimentally whether the flocculent separation of globulin from the serum of syphilitics by means of organ extracts and cholesterin would yield the same results as the Wassermann test.

They devised a relatively simple technique and published some interesting results in 1918. Since that time many workers have repeated their observations and the majority have arrived at the conclusion that the flocculation test is likely to be of practical importance in the future. The two originators have now collected records of over 12,000 tests performed by themselves and 18 other workers.[1] The flocculation test and the Wassermann test coincided in 92.44%. In 3.1% the Wassermann test proved positive or was doubtful, while no flocculation occurred; in 4.3% there was either no response to the Wassermann test or a doubtful response and flocculation was obtained. In many of the latter the clinical evidence was strongly in favour of a syphilitic infection. But in a still larger number the assumption of a syphilitic infection could not be made. It is possible that means may be found to increase the delicacy of the flocculation test. The authors describe one set of modification by means of which the disturbing effect of low temperatures in the laboratory may be eliminated. Be this as it may, it would seem as if this test might prove of considerable value in confirming or correcting doubtful responses to the Wassermann test in cases in which syphilis is suspected from the clinical signs and symptoms. The flocculation test is carried out by placing 1 c.cm. of a 10% dilution of the serum to be tested in a test tube together with 0.5 c.cm. of an alcoholic extract of heart to which cholesterin has been added. Controls must be prepared. The mixtures may be kept for two hours in the incubator and then allowed to stand at laboratory temperature over night, or they may be kept for from 18 to 20 hours in the incubator. The extract must be very carefully prepared and the optimum amount of cholesterin to be added, must be determined experimentally. The extract is diluted with six times its volume of physiological salt solution. Those who are interested in the technical details of the test, are recommended to refer to the original article.

PROTEIN SENSITIZATION AND ECZEMA.

Demonstration of the fact that infantile eczema is not infrequently an allergic phenomenon due to a condition of protein sensitization has led to the suggestion that eczema of adults might be found in certain cases to be of similar nature. Although it is generally recognized that the action of a local irritant may be responsible for the larger number of cases of eczema in adults, in every series of cases studied there remain a certain number to which a definite ætiological basis cannot be readily assigned. The possibility of an anaphylactic origin for such cases was suggested by Fordyce in 1911. Since that time the subject of protein sensitization has received much attention, particularly in the study of the common disorders of infancy, asthma, urticaria and infantile eczema. More recently Drs. Howard Fox and J. Edgar Fisher[2] have studied the question in relation to the eczema of adults. In addition to their own observations in a series of 60 patients, these authors have endeavoured to analyse the results of other observers working on this subject. The method of testing for protein sensitiveness employed was a slight modification of that made familiar by the work of Walker, in which a cutaneous reaction is sought by the application of solutions of various proteins to small scarifications made upon the flexor aspect of the forearm or upon the skin of the anterior abdominal wall. Small excoriations were made comparable to those used for the cuti-reaction of von Pirquet in cases of suspected tuberculosis. On each abraided surface there was placed a small quantity of protein, to which was added a drop of decinormal sodium hydroxide solution to dissolve the protein and to permit of its rapid absorption. At the end of half an hour the reactions were noted. A positive reaction consisted of a raised white elevation or urticarial wheal surrounding an abraided area. The reaction was regarded as positive when a wheal not less than 0.5 cm. in diameter was produced in the presence of negative controls.

This cutaneous test is regarded as specific and more satisfactory than the intradermal method previously advocated by various writers. Of the 60 patients examined, 41 were found to give no definite reaction, whereas sensitiveness to various proteins was demonstrable in the remaining 19 instances.

The proteins used in each case were derived from common foodstuffs, such as cheese, onion, cabbage, tomato, oyster, etc.. Each individual was tested with from 13 to 37 proteins. In several instances proteins of epidermal origin, such as those derived from horse dandruff, dog hair and chicken feathers, were employed in addition to those obtained from articles of diet.

Treatment of the patients was modified by the elimination of the offending substance from the dietary where this was possible. Subsequent observations in these cases were regrettably incomplete, so that it was difficult to draw definite conclusions from the experiments. In general, the results obtained were in accordance with those of other observers, in that certain patients who showed marked sensitiveness to a particular protein, were in some cases greatly ameliorated by the restriction from the dietary of the particular substance concerned. In many other instances patients were found to react to various vegetable proteins and the results seemed inconclusive. It appears that considerable further investigation must be undertaken before the value of this principle can be rightly appraised. It is, however, probable that testing for protein sensitization will ultimately prove to be of assistance in the treatment of a small proportion of cases of eczema in adults.

[1] *Arbeiten a.d. Institut für Experimentelle Therapie, Heft* 10, 1920.
[2] *Journal of the American Medical Association*, October 2, 1920.

In our issue of October 23, 1920, we published an advertisement calling for applications from candidates for the positions of Honorary Director of the X-ray Department and Honorary Assistant Radiographer, Honorary Assistant Physician and three Honorary Assistant Medical Officers for the Venereal Diseases Clinic at the Royal Prince Alfred Hospital. The following have been appointed to these positions: Dr. H. R. Sear, to succeed the late Herschel Harris; Dr. W. B. Dight, Dr. F. J. Bridges, to succeed Dr. P. Walton Smith; and Drs. N. M. Gibson, J. C. Booth and C. J. Wiley.

Abstracts from Current Medical Literature.

OPHTHALMOLOGY.

(167) Colour Blindness in Females.

Ingolf Schiötz has conducted a research into the incidence of colour blindness in women and compares his results with those of other workers (*Brit. Journ. of Ophthalm.*, August, 1920). Stilling's pseudo-isochromatic tables were used as the main test and those of Podestà and Nagel and spectral colour mixtures for further tests. Among 1,270 girls, 11 were found to be dichromatics and anomalous trichromatics. In a further series of 930 girls, three were red-green blind and six others to a lesser degree. Hence 1% of women may be considered colour blind. Observations on men by the author and others reveal 10% of colour blindness. The author recalls the main points of the Mendelian theory. The male and female gametes unite to form the new individual—the zygote. The gametes contain and transmit the hereditary material—the genes. Each gamete carries one gene for the character in question. The zygote resulting from the union of male and female will be homozygous, if the genes are identical, and heterozygous if the genes are different. Of two contrasted characters meeting at fertilization, one may appear in the offspring, thus suppressing the other; this character is said to be dominant, while the other is recessive. Brown irides depend on a dominant gene and illustrate this law. The genes are carried by the chromosomes, small rod-shaped or V-formed bodies, contained in the cell nucleus. With one exception these chromosomes are arranged in pairs and during the ripening of the germ cells these two series separate, so that the sex cells contain only one of these homologous series of chromosomes. The exception relates to a single pair of chromosomes, which is only in the female present as a pair, while the male in his cells has but one member of the said pair. These chromosomes are called the sex-chromosomes or X-chromosomes. Since the female has two X-chromosomes in her cells, the cell after maturation will contain one X. As the male cell has only one X-chromosome, this element will at the maturation division pass undivided to one of the two daughter-cells, leaving the other with no X-chromosome. Hence there are two kinds of spermatozoa, one containing an X-chromosome and the other without such an element. At fertilization an egg which always contains an X-chromosome, may be fertilized by a sperm also containing an X and the offspring will contain two and be a female. If the egg be fertilized by a sperm without an X, the offspring will contain only one X and be a male. Applying this theory of sex determination, worked out by E. B. Wilson, to the inheritance of colour blindness, it becomes quite clear why colour blindness is ten times more common in men than in women. It is assumed that colour blindness is a recessive character and that the gene for colour blindness is carried by the sex-chromosome. When a colour-blind man marries a normal woman, his daughter will receive one affected sex-chromosome from him and a normal one from the mother. Being recessive, the anomaly will not be manifest, but she will be a conductor; if she marries a normal man she will transmit the gene for colour blindness to half her sons and half her daughters. A red-green blind woman must necessarily have received the hereditary gene from both parents. The various possibilities are interesting to work out.

(168) Tubercular Disease of the Cornea.

E. B. Miller believes that tubercular disease of the cornea is of common occurrence and that it may even be associated with a positive Wassermann reaction and other evidence of syphilis (*Penns. Med. Journ.*, August, 1920). There are four types in which tubercular infection is frequently present: (*i.*) phlyctenular keratitis, which may be caused by toxins and not by living germs; (*ii.*) fascicular keratitis or migratory pustule, in which the phlyctenule leaves the periphery and creeps towards the centre of the cornea accompanied by a bundle of blood vessels; (*iii.*) parenchymatous or interstitial or diffuse keratitis, occurring most frequently in children between five and sixteen; (*iv.*) sclerosing keratitis, common in rheumatic subjects, forming part of a general scleritis. A positive response to the von Pirquet test and rapid improvement under tuberculin indicate that a number of these cases are due to tubercular foci. The author adduces the following statement in support of his contention that these cases are of tubercular origin. In the literature there is an ever increasing tendency to accept the tubercular ætiology. The von Pirquet test repeated and followed by diagnostic injection of tuberculin often brings about a reaction in the eye, even in the area in which the von Pirquet test was previously applied with negative result. In many patients whose serum yields a positive response to the Wassermann test, there is often present an added tubercular infection, as shown by tuberculin tests; these cases drag along until tuberculin is used and then speedily clear up. Careless methods of administering tuberculin are often responsible for the apparently unfavourable result, while the carefully graded dose method is readily borne and produces no apparent discomfort to the patient and yields good results in a remarkably short time. Instructions are given for the best doses of tuberculin.

(169) Pulsating Exophthalmus.

W. M. Posey's first case in which he employed partial ligature of the common carotid artery for the treatment of pulsating exophthalmus was that of a man 66 years old, who two years previously had a fractured base, the result of a fall (*The Penns. Med. Journ.*, August, 1920). He had exophthalmus on both sides, the left eye being 6 mm. in advance of its fellow. Both eyes were almost immobile; the vision was reduced to the perception of fingers; both discs were atrophic. A mass of orbital vessels was palpable under the orbital rim. A thrill could be felt. Pressure on the right common carotid artery controlled the pulsation, thrill and bruit. The right common carotid was partially ligatured under local anæsthesia and a prominent venous plexus in the orbit was also ligatured with catgut. The patient was kept quiet for two weeks, with little food, and at the end of a month the exophthalmus had almost entirely gone and vision was much improved. The second patient, male, aged 50, also had a fall 18 months before. Four weeks before examination the left eye became suddenly inflamed and proptosed. The ocular movements were unimpaired except below. The proptosis was overcome by firm pressure. Pressure on the left common carotid artery stopped the pulsation and bruit. Ligature of the left common carotid artery was followed by reduction of the exophthalmus, but hemiplegia ensued and the patient died. The third patient, a woman aged 43, had a fractured base from a motor car accident a year previously. Both eyes had become proptosed, especially the right. Both orbits contained a mass of pulsating blood vessels and a bruit was audible. Pressure on the left common carotid artery caused a cessation of the roaring in the head and the audible bruit. Under novocain the left common carotid artery and the veins of the right orbit were ligatured and coagulose was injected into the same cavity. Considerable improvement followed the operation. Complete ligation of a single carotid is followed in a large percentage by cerebral softening.

(170) Primary Actinomycosis of the Conjunctiva.

Brunetière, of Bordeaux, reports a case of conjunctival actinomycosis in a young soldier who was employed in shaking up old straw mattresses and brushing the overcoats (*Journal de Médecine de Bordeaux*, September 10, 1920). The most striking feature was the formation of a false membrane over the tarsal and bulbar conjunctiva which caused bleeding on removal and quickly formed again. In spite of various forms of treatment the condition remained the same for two years, with iridocyclitis supervening. Ruhenthaler finally made the bacteriological diagnosis of actinomycosis from the tissue beneath the false membrane. Treatment by iodides in doses up to the patient's tolerance (three grammes per day) produced a rapid improvement. The man's employment suggests the means of infection.

LARYNGOLOGY AND OTOLOGY.

(171) Total Laryngectomy.

When the whole interior of the larynx is involved by a new growth Charters J. Symonds thinks that nothing short of complete extirpation offers a good prospect of immunity (*Journ. Laryng., Rhin., Otology*, September, 1920). If the disease, chiefly unilateral, has penetrated the cartilage and involved the muscle, extirpation of the whole larynx is advisable. When there is involvement of glands in the carotid triangle a partial removal may suffice if the disease is confined to one side of the larynx. The author prefers ether anæsthesia preceded by morphine and atropine until the trachea is opened, then chloroform by a Junker's apparatus. A vertical median incision from the upper border of the hyoid to 1.8 cm. above the sternum is made and deepened to the cartilage, the thyreoid isthmus being divided. The sterno-hyoid and thyreo-hyoid are next divided and the lobes of the gland having been separated from the trachea, the inferior thyreoid arteries are secured. The parts are retracted and the attachments of the constrictors from the thyreoid and cricoid cartilages are separated. The upper border and inner surface of the thyreoid cartilage are exposed and the superior thyreoid artery is secured. A 10% solution of cocaine is injected into the trachea immediately below the cricoid, the trachea and larynx are protected by gauze and the former is divided between the first and second rings, a gauze plug being inserted into the proximal aperture. The distal portion is separated from the œsophagus and sutured into the lower angle of the wound. A special tracheotomy tube is inserted and secured. The larynx is then separated from the below upwards to the upper border of the thyreoid cartilage. The cartilage is divided below this border and the pharynx is closed by three rows of continuous sutures, the first through the mucous coat by No. 0 twenty-day chromic catgut, the second and third through the muscle of the pharynx. The skin is then sutured over a strip of gauze six layers thick and a small-sized rubber drainage tube surrounded by ribbon gauze is inserted below the hyoid down to the pharynx. A moist gauze dressing covered by narrower jaconet and this by wool is secured in position by three strips of bandage tied in front. A thin rubber tube, No. 10, containing a silver wire is passed through the mouth into the œsophagus. The patient is placed propped up on pillows and may swallow water as soon as he is able. The large gauze pack is replaced by a smaller one after 48 hours. The upper drain can be removed on the fourth day and the feeding tube can be dispensed with after this day.

(172) The Ear in Typhus and Relapsing Fevers.

According to A. Costiniu (*La Presse Médicale*, July 7, 1920) nearly 70% of patients suffering from typhus in the Serbian hospitals were found to have the ears involved; the incidence in relapsing fever was much less. All degrees of involvement were met with. As a general rule tinnitus and dulling of hearing synchronized with the onset of the rash. A few patients complained of earache. There was generally intense hyperæmia of the naso-pharyngeal mucosa and the tympanic membranes. There was practically no mastoid tenderness. The middle ear alone was generally affected, but in 10% of cases the internal ear was attacked. In some cases the mastoid was involved and was found at operation to leave the bony tissue almost completely absorbed. The healing of these cases was slow, owing to the general loss of vitality of the tissues. In the cases in which naso-pharyngeal and buccal antisepsis was observed from the outset, ear affections were more rarely seen or of less severity and with a more rapid recovery. There was laryngeal involvement in 15% of the typhus cases and in a lesser percentage of cases of relapsing fever. Onset generally coincided with the commencement of convalescence. There is generalized œdema of the laryngeal and perilaryngeal structures with dysphagia, dyspnœa and dysphonia. Tracheotomy may be required. Diphtheria, without characteristic lesions, frequently occurs and demand immediate injection of diphtheritic serum. The prognosis in cases with laryngeal involvement is serious.

(173) The Ear in Aviation.

Sydney Scott (*Journ. Laryng., Rhin., Otology*, August, 1920), from an examination of upwards of 300 flying officers of the British Expeditionary Force, emphasizes the importance of efficient Eustachian tubes, whereby airmen can regulate and equalize the continuous changes of atmospheric pressure experienced. Faulty tubes may result in deafness and distress in the ears, as well as vertigo, vomiting and forced movements. Scott holds that airmen should not fly with a cold in the head, sore throat or when unable to inflate both Eustachian tubes at will. If they can open the tubes at will by swallowing, they should use chewing-gum to stimulate the flow of saliva and keep swallowing when descending from high altitudes. If they cannot rely upon opening the Eustachian tubes repeatedly and rapidly, they should make it a rule to self-inflate the ears by Valsalva's method, beginning to do so at the commencement of the descent and repeating the procedure every 1,000 feet. By opening the mouth slightly and trying to maintain the lower incisor teeth as far in front of the upper as possible, considerable changes of atmospheric pressure may be passed without having to swallow or inflate the ears. The rotation labyrinth test was tried in many cases, but was ultimately abandoned, because the results were considered to show that the test was unnecessary for the purpose of investigating the special ailments attributable to flying. It was inferred that the rotation tests did not serve to discriminate qualities either favourable or unfavourable to individual flying ability.

(174) Hysterical Deaf Mutism.

A youth, aged 18, who appeared completely deaf, but whose vestibular reactions were perfectly normal, was examined by A. F. Hurst and W. M. Mollison (*Proc. Roy. Soc. Med.*, Vol. XIII., No. 2, December, 1919). His mother stated that he heard quite well when a small baby. She did not know when he became deaf; it was probably after a slight illness or a fall on the head between the ages of 3 and 9 months. The patient was told by lip-reading, at which he was proficient, that he could not hear because he had never tried to listen and he was assured that if he once made the effort to listen he would begin to hear. He succeeded in hearing his own name. He soon learned to hear a number of words, but each word had to be taught separately and conveyed nothing until explained by lip-reading. When once learned he could afterwards understand it, but for long he could only listen for a few moments. He ultimately could hear all ordinary sounds, but had no idea of pitch and could not distinguish one note of music from another. There was no evidence of disease of either the inner or middle ear, though prior to treatment deafness to both air- and bone-conduction was absolute and the auditory motor reflex was completely absent. This reflex became quite normal.

(175) Cicatricial Laryngeal Stenosis in Children.

E. J. Moure (*Journ. de Méd. de Bordeaux*, February 10, 1920) describes two varieties of cicatricial laryngeal stenoses. The rarer type follows ulcerations of the laryngo-tracheal passage in diphtheria, measles, scarlatina and occasionally enteric fever, the commoner form occurs after so-called tracheotomies, through the thyreoid, the cricothyreoid membrane, or the cricoid. When an attempt is made a few days or weeks later to remove the cannula, respiratory distress follows and the cannula has to be re-inserted. In these cases the arytenoids are found infiltrated and fixed in a median position and there is subglottic œdema. Often the reintroduction of the cannula in a good position in the trachea is all that is required to relieve the stenosis, which is more inflammatory than cicatricial. The œdematous tissue slowly subsides and most children with chronic laryngeal atresia can ultimately be decannulated. The children must be taught to breathe through the natural channels, closing their cannula during the day at first and afterwards during the night. Patience and time are needed. Meanwhile, the surgeon must, with knife or cautery, control the exuberant pericannular granulations which invariably appear during the earlier months. Moure holds that laryngostomy, the opening of the narrowed cavity and subsequent dilatation should not be performed before the child is seven or eight years old.

British Medical Association News.

SCIENTIFIC.

A meeting of the Victorian Branch was held at the Medical Society Hall, East Melbourne, on September 8, 1920, Mr. G. A. Syme, the President, in the chair.

Dr. Reginald Webster read a paper entitled "Lumbar Puncture and Meningitis" (see page 487).

Dr. W. J. Penfold conveyed his thanks to Dr. Webster for his very interesting paper and expressed himself as especially gratified to think that experimental pathology was not altogether neglected by the Branch. Dr. Webster had laid great stress upon pneumonia as being primarily a bacteræmia with subsequent localization in the lung and, indeed, had suggested that the usefulness of his work in respect of pneumococcal infections largely depended upon that fact. Blake and Cecil, in the *Journal of Experimental Medicine* (April, 1920), had shown that by the intratracheal injection into monkeys of pneumococcal broth culture in amounts varying from 1 c.cm. to 0.00001 c.cm. they could produce, almost regularly, typical lobar pneumonia. In all 87 experiments were performed, with 32 successes. They concluded, therefore, that lobar pneumonia was essentially bronchiogenic in origin. The observers named had found, moreover, that they were unable to produce localization in the lung by the induction of experimental pneumococcal septicæmia in monkeys, intravenous and subcutaneous injections being both tried unsuccessfully; they had formulated their belief that the bacteræmia found in pneumonia was secondary to the pneumonia. Their evidence was extremely good in support of that contention.

The criteria employed by Dr. Webster for the identification of the pneumococcus, while probably sufficient, might have been improved upon. The bile-soluble, Gram-positive diplococci constituted a very large group of organisms, of which three fixed types had been described by American workers; in the fourth group no less than twelve sub-groups had been described, all giving the reactions of atypical Type II. strains. The group was large and complex and it seemed to him that if these experiments had been done with one of the more rarely occurring pneumococci and the identification of the strain got out of the animal body had been completed by serological tests, the evidence would have been more convincing. If, for example, a Type IV. organism had been introduced into the blood and Type I. organism had been recovered from the cerebro-spinal fluid, the most natural assumption would be that the meningitis did not arise from the septicæmia, but rather from contamination locally. In view of the well-known fact that the pneumococcus was extensively distributed in the mouths of normal persons and outside the body in dust and elsewhere, the possibility of such contamination could not be ignored.

In the case of the monkey that developed meningitis, in the first series recorded by Dr. Webster, several lumbar punctures were required to produce the condition. It seemed doubtful whether so many lumbar punctures would be likely to be required in diagnosis. The question of a large number of punctures being required for treatment did not arise in this connexion. Dr. Webster had made a plea for caution in the use of diagnostic lumbar puncture.

Dr. Penfold said that he would be indebted to Dr. Webster for a statement of the number of pneumococci per cubic centimetre of blood in the monkeys at the actual time when the lumbar punctures were made. A study of the literature did not lead to the conclusion that in the secondary bacteræmias of pneumonia the numbers were great. The importance of this paper on the practical side would therefore depend on the demonstration that the quantitative relations were similar in the two cases. Dr. Penfold suggested that the intratracheal inoculation of virulent pneumococci might be employed to produce the pneumonia and that the secondary septicæmia arising from that lobar pneumonia might be used for the production of the meningitis. This septicæmia would be similar to that which would be liable to be found in the human subject in such cases. In the cases in which the pneumococci were injected into the blood and in which the lumbar punctures were undertaken forthwith, it seemed highly likely that the number of pneumococci per cubic centimetre of blood was greatly in excess of the numbers actually found in pneumococcal septicæmia.

Dr. R. R. Stawell said that he wished to express his deep appreciation of Dr. Webster's interesting and most valuable paper, valuable not only because of its original work, but valuable because of its extremely important suggestions as regards clinical practice.

As regards Dr. Penfold's remarks, it must be pointed out that lumbar puncture had become a routine, not only in diagnosis, where it was absolutely necessary and extraordinarily valuable, but as a measure of treatment, in which it was exceedingly doubtful whether it was of any permanent value. It would now appear from Dr. Webster's investigations that it might conceivably be of some harmfulness. The clinical outcome of Dr. Webster's work would be that lumbar puncture should now be undertaken with thought and discrimination and not merely as a routine procedure. The whole experimental work opened up very many interesting problems, especially the problems concerning the full function of the cerebro-spinal fluid, the full meaning of the term "meningo-choroidal defence." By this term, "meningo-choroidal defence," was it meant that the meninges, as well as the choroid modification of the meninges, was to be regarded as a "boundary"? It seemed to him (Dr. Stawell) that it would be unreasonable to suppose that a mere lumbar puncture could so instantly and seriously affect the choroid gland that all its mechanism was broken down. He could not help feeling that the physiology of the cerebro-spinal fluid still required a great deal of investigation before any complete certainty could be held on the subject.

In connexion with the path of infection in Dr. Webster's experimental cases, was it not reasonable and probable that during a septicæmia the mere puncture of the meningeal membrane would infect the sub-mengineal fluid and was it not possible that too little stress had been laid upon mere traumatism of the part and the opening up of a direct track of investigation through the lumbar puncture? He would suggest to Dr. Webster that if it was possible to extend his investigations, mere puncture of the lumbar space should be undertaken without removal of any fluid and without the introduction of any foreign substance.

Dr. Paul Dane tendered his congratulations to Dr. Webster and remarked that he had followed with much interest the considerable amount of work that had been performed recently in America on the cerebro-spinal fluid and lumbar puncture. Fears had been expressed by some observers that lumbar puncture was not without its dangers, especially when used on patients for therapeutic purposes.

The condition of the cerebro-spinal fluid in the various stages of acute febrile disorders had not been systematically studied, especially in relation to the state known as meningism or meningismus. Two observers, Herrick and Danneberg, had made a study of the cerebro-spinal fluid in a series of 76 cases of acute febrile disease not resulting in meningitis in any one case, but comprising for the most part cases of lobar pneumonia and broncho-pneumonia. The observers named showed that about one-third of the fluids examined manifested distinct evidence of meningeal reaction. The majority, but not all, of the patients from whom these fluids were withdrawn exhibited the clinical condition called "meningism." On the other hand, in many cases of "meningism," there was nothing abnormal in the cerebro-spinal fluid. Further, after an experience of 5,000 lumbar punctures in a large military centre, undertaken during the course of a diversity of medical conditions without a single case of meningitis developing, Herrick and Danneberg concluded that the danger of meningitis supervening on lumbar puncture was very small indeed.

Dr. Dane said that Dr. Webster's paper had displayed originality of thought and the utmost care and patience in following the experiments to the end, but after all, in this, as in most other problems, they were bound to be guided largely by clinical experience and must not allow undue importance to attach to laboratory experiments on animals. Conditions in the laboratory were always dissimilar to the actual happenings in clinical work. He thought that clinical experience would show that there was very little danger of meningitis developing as the result of lumbar puncture, but it seemed wise, as Dr. Webster had suggested, to limit

the operation when used diagnostically to the withdrawal of as small an amount of cerebro-spinal fluid as would suffice for the pathological examination.

As it was almost certain that the cerebro-spinal fluid was a filtrate through the meningo-choroidal apparatus, it seemed unwise to lower the pressure unduly in the lumbar cistern, for the pressure was generally increased in the early stages of acute infections. This might be a protective mechanism, to allow the meningo-choroidal apparatus time to develope its defences against the invading organisms. An organism, such as the meningococcus, appeared to get through the defences very easily. He, therefore, suggested that when lumbar puncture was performed during the early stages of acute infections, only a small amount of fluid should be withdrawn, but that later on larger amounts might be withdrawn and the operation might be repeated, without incurring the same risk of meningitis. At the later period the meningo-choroidal defences would be better organized against a sudden filtration of organisms into the cerebro-spinal space. In conclusion, Dr. Dane remarked that no instance of meningitis developing upon lumbar puncture had come within his personal experience.

The President congratulated Dr. Webster on his excellent and stimulating paper and also the Branch on having it to discuss. It was a type of paper embodying original research, too rarely presented at Branch meetings; he hoped it was an earnest of future contributions of a similar kind.

The formation of a number of new associations, like the Medical Club, the Surgical Association and the Gynæcological Association, in addition to the existing Pædiatric and Ophthalmological Societies, had been adversely criticized. At the recent meeting of the Australasian Medical Congress the proposal to form an Australasian Surgical Association had been discussed by the Section of Surgery and rejected in favour of the formation of surgical sections by the Branches of the British Medical Association. It was argued that these separate societies tended to diminish interest in the British Medical Association and to deprive the Branch meetings and the official organ of papers. On the other hand, it was urged that the existence of these societies would stimulate research and lead to increased activity in the Branch. If other members followed the example of Dr. Webster, this result would be obtained. It rested with members of the new societies to see that the Branch did not suffer.

With regard to the subject matter of the paper, Mr. Syme said that he did not feel competent to offer any criticism, but the same idea occurred to him as to Dr. Stawell, that the traumatism of the puncture might be a factor. He ventured, diffidently, to suggest that further control experiments might be advisable before drawing final conclusions. Dr. Webster had, however, indicated the need for caution in routine performance of lumbar puncture in the possible presence of pneumococcic and other infections.

Dr. Webster, in reply, remarked that the discussion had furnished another instance of the habit of clinicians to subject the work of the laboratory, in so far as it bore upon clinical practice, to close scrutiny and criticism; that, of course, was as it should be. If he might reply to the last speaker first and discuss the question of controls raised by Mr. Syme, he wished to point out that a control animal was furnished for every experiment in which meningitis developed. The limited number of monkeys at his disposal and the very great difficulty in obtaining these animals, precluded a larger series of control experiments, but, at the same time, he thought that he had provided all essential controls.

Dr. Penfold had discussed the bacteræmia of pneumonia and had quoted recent work from which it appeared that the invasion of the blood stream by the pneumococcus was a secondary event, the primary process being pneumonic consolidation sequent on direct extension of the organisms along the respiratory tract. He (Dr. Webster) was not familiar with the experimental work to which Dr. Penfold had referred and certainly had considered the subject of pneumococcus infection and pneumonia from the point of view of a primary septicæmia. He had carried out one experiment, not recorded in the paper, which approximated those referred to by Dr. Penfold. He had given a monkey an intra-pulmonary injection of pneumococci. The animal subsequently exhibited a raised temperature, rapid respirations and short, hard cough, which eventually became looser, prior to clearing away. This monkey received two lumbar punctures during the course of the pneumonia, but no evidence of meningitis could be detected. Unfortunately, a blood culture was not secured in that instance.

Dr. Webster observed that whether the septicæmic phase of pneumonia were primary or secondary, the experience of several years at the Children's Hospital had impressed him with its reality and frequent severity. In regard to the question of "types" of pneumococcus, Dr. Webster said that he had endeavoured to obtain the specific sera essential for the type identification without success. At the same time, he ventured to think that, for the purposes of his work, the type of classification of the pneumococcus was not a matter of very great moment. Throughout the course of the experiments, he had been more concerned with the question of virulence and had attempted by various means to maintain an exalted virulence in the pneumococci employed.

He was not in a position to answer Dr. Penfold's query relative to the number of organisms present in the monkeys' blood at the actual time that the lumbar punctures were made. His only observations bearing upon this point were of a qualitative character and consisted in examinations of stained films of blood from the septicæmic animals. It was the exception to find pneumococci in such films. In view of the fact that only two animals died of the septicæmia *per se*, he did not think that the experimental septicæmias were so overwhelming as to place them beyond comparison with those met with clinically.

As Dr. Stawell had emphasized, the possibility of infection of the meninges through the actual puncture could not be ignored and, if opportunity offered, he would follow Dr. Stawell's suggestions upon this point.

In conclusion, Dr. Webster asked that the purport of his work should not be misunderstood. It would ill become him to attempt to lay down rules for men of wide clinical experience, but he thought he was warranted in urging that lumbar puncture under circumstances such as he had detailed, should be well considered.

He wished to thank the members for the kind manner in which they had received and discussed his paper.

MEDICO-POLITICAL.

A meeting of the Victorian Branch was held at the Medical Society Hall, East Melbourne, on November 10, 1920, Mr. G. A. Syme, the President, in the chair.

The President introduced the subject of the proposal to send a representative of the Branches of the British Medical Association in Australia to a conference to be held next year of representatives of the overseas Branches with the Council of the Association. The Representative Body had resolved to summon this conference for the purpose of considering the alterations of the Articles and By-laws necessary to give effect to the proposal to admit to membership of the Association societies and incorporated bodies. He explained that the matter had originated in the action of Dr. W. T. Hayward, C.M.G., who, as a member of the Council appointed by the Victorian and South Australian Branches, had brought forward the question of the limited powers of the overseas Branches. Mr. Syme stated that certain of the Australian Branches wished to become incorporated. Under the existing constitution the Council had held that this was not permissible. The existence of the Medical Society of Victoria surmounted some of the difficulties in Victoria, but these difficulties embarrassed some of the other Branches.

The Federal Committee had repeatedly emphasized the difficulties and had considered the question at its last meeting. Correspondence was read from the Council of the Association, suggesting the conference and notifying the Federal Committee that careful consideration had been given to the whole question of ways and means to grant the greater autonomy desired by the overseas Branches. The Federal Committee had concluded that effective representation of the several Branches in Australia could only be accomplished by someone sent for the purpose. It was essential that the representative chosen should be well versed in the affairs of the Association and that he should

have an intimate knowledge of the constitution. The Federal Committee has resolved:—

(i.) That the Committee is of opinion that a representative of the Branches of the British Medical Association in Australia should be sent to England to act at the conference of representatives of the overseas Branches with the Council, arranged at the Annual Representative Meeting, 1920, to be held in connexion with the proposed alterations of articles and by-laws.

(ii.) That in the event of the Branches agreeing to the resolutions, they be requested to provide the necessary funds to meet the expenses of the representative (estimated at 7s. 6d. per member). (See *The Medical Journal of Australia*, September 11, 1920, page 252.)

Mr. Syme said that the Federal Committee wished to ascertain the views of the Branches and the matter had therefore been brought forward at that meeting. The members were asked to decide:—

(i.) Whether they favoured the sending of a representative; and

(ii.) Whether they agreed to provide the necessary funds by a contribution of 7s. 6d. per member for one year.

Mr. W. Kent Hughes said that he felt very strongly on the question of the relationship of the overseas Branches to the parent Association. The Council had recently demanded a subscription of £1 18s. per member, an advance of 17s. on the existing rate of one guinea. He considered it preposterous that the members in Australia should be called upon to pay thirty-eight shillings for the right of reading the *British Medical Journal*. If the aggregate sum represented by that subscription were spent in Australia, what a journal they could have! He did not think it right that the members of the several Branches in Australia should pay for the extension of the organization of the British Medical Association in England, Scotland and Ireland. He was averse to the proposal to send a representative to England to ask for autonomy for the overseas Branches. He thought that the time had come for these Branches to act independently. He therefore moved:—

That it be an instruction to the Victorian delegates on the Federal Committee to consider seriously the question of the formation of an Australian Medical Association.

The motion was seconded by Dr. Charles Sutton.

Mr. G. A. Syme said that he could not agree with Mr. Kent Hughes. The action proposed in the motion was premature without further consideration and in the absence of information as to what the other Branches in Australia were going to do. One of the objects of the projected conference was to devise a scheme of affiliation of the overseas Branches with the parent Association by which greater autonomy could be granted the former. At two meetings of the Australasian Medical Congress he, the speaker, had been one of those who had advocated the formation of an independent Australasian association. But he had changed his view and considered that it would be a grave mistake on the part of the Australian Branches to part company with the British Medical Association. An example of the advantage accruing to membership of the world-wide organization of the British Medical Association had been furnished quite recently during the course of the lodge dispute. The failure of the mission to secure doctors in England for the medical institutes was largely due to the assistance rendered the Victorian Branch by the Council of the British Medical Association. Mr. Syme reminded members that the Council of the Victorian Branch had sent a protest against the increased subscription. He said that this protest should receive favourable consideration. He felt bound to oppose Mr. Kent Hughes's motion.

Dr. J. W. Springthorpe felt that the subject under discussion was very important. He would like to have more information before voting. The meeting was a small one and therefore scarcely representative. He moved as an amendment:—

That a précis of the situation be forwarded each member of the Branch and that the matter be further considered at a meeting arranged by the Council.

The amendment was seconded by Dr. James Booth.

Mr. Kent Hughes withdrew his motion and the amendment on becoming the substantive motion, was carried unanimously.

On the motion of Dr. F. L. Davies, Drs. C. H. Mollison and W. Kent Hughes were appointed to act as scrutineers in the election of office-bearers and members of the Council for the ensuing year.

The undermentioned have been elected as members of the New South Wales Branch:—

E. F. Fisher, Esq., M.B., 1920 (Univ. Sydney), State Hospital, Lidcombe.

J. A. Kennedy, Esq., M.B., Ch.M., 1919 (Univ. Sydney), 423 Marrickville Road, Dulwich Hill.

B. C. Kennedy, Esq., M.B., 1913 (Univ. Sydney), East Maitland.

E. W. B. Woods, Esq., M.B., Ch.B., 1916 (Univ. Melb.), Albury.

G. L. L. Lawson, Esq., L.R.C.P., M.R.C.S., D.P.H., Pymble.

It is announced in the *Victoria Government Gazette*, No. 205, of November 16, 1920, that the Commission of Public Health has determined that public vaccination may be performed at specified times in nine additional premises. These are the surgeries of Dr. J. Booth (220 Victoria Street, North Melbourne), of Dr. P. G. Clarke (Florance Street, Mentone), of Dr. H. W. Lording (6 Rosstown Road, Carnegie), of Dr. K. A. Stephenson (Service Street, Clunes), of Dr. C. J. Simpson (Toole Street, Hopetown) and of Dr. J. Bell (Grey Street, Toora), as well as at Callaghan's Hotel, Lascelles, O'Connor's Hotel, Woomelang, and Welshpool Hotel, Welshpool.

TRANSMISSION OF PATHOLOGICAL SPECIMENS BY POST.

We have been informed by a correspondent that the Department of the Postmaster-General, after having been mildly bombarded with a series of awkward facts, has determined to concede a point, albeit a very small point, in regard to the transmission of pathological and bacteriological specimens. A new rule has been introduced as follows:—

In cases where specimens (throat swabs) are not obtained in time to permit the sender to pack them and hand the packet in at a post office for registration, on account of the post office having closed for the day, such specimens may be transmitted by ordinary post, provided they are properly packed in accordance with this Regulation, and the packet bears an indorsement by the sender that the specimen enclosed was obtained too late to permit the sender to hand the packet in at a post office for registration.

KALYRA SANATORIUM, BELAIR, AND ESTCOURT HOUSE.

The Chairman of the James Brown Memorial Trust has published his annual report for the year ended June 30, 1920, in which he expresses the thanks of the Trustees for the excellent work carried out by the medical, nursing and domestic staffs at the Kalyra Sanatorium and at Estcourt House (South Australia).

Kalyra Sanatorium.

On July 1, 1919, there were 40 patients undergoing treatment in the Sanatorium. During the course of the year 85 patients were admitted, while on the last day of the 12 months 28 were still under treatment. Only one patient died. Of the 96 patients discharged, 28 were admitted with their disease described as "Class I.," by which is meant that not more than one lobe or two half lobes were affected. In this class the lesions are described as slight. Arrest of disease was obtained in 15 patients, while improvement resulted from the treatment in 12. The number of patients comprising Class II. was 49, or 50 if the patient who died be included. The disease was arrested in three of these patients, while improvement was achieved in 34. The number of patients calculated under Class III. was 19. In none of these was arrest of disease obtained, while 17 were discharged unimproved. The cases included in Case II. are those in which there is a slight lesion extending further

than the lesion of Class I., but not occupying more than the volume of two lobes or a severe lesion involving the volume of one lobe or less. All the more extensive or severer lesions are included in Class III.. There were thus 97 patients in whom the treatment was concluded. The average length of residence in the Sanatorium was 136 days. The patients included in Class I. were under treatment for 104.1 days on the average, those included in Class II. 177.7 days and those included in Class III. 84 days. The majority of the patients gained in weight during the treatment. In regard to the age of the patients, the oldest of those discharged was 56 years and the youngest six. The average age was 29.9. Cough appears to have been the first symptom in 48 of the patients, debility in 19, hæmoptysis in 11 and pleurisy in five. The number of patients admitted to Kalyra within three months of apparent onset was 24; 23 were admitted within six months, 14 within nine months and 9 within twelve months. Tubercle bacilli were found in the sputum of 78 patients. It is noted, however, that the sputum was examined in only 89.

It appears that when the patients fail to respond to other means of treatment, recourse is had to artificial pneumothorax. Dr. J. W. Browne is convinced of the value of this treatment in selected cases. It was carried out in 17 patients, of whom six were much improved, eight were improved and three unimproved. The inhalation of sulphur dioxide was found useful, especially in laryngeal and catarrhal cases. Tuberculin is not employed. There is a grave defect in the report in the omission of all records of the present condition of persons discharged within the past ten years. The record of arrest or improvement estimated immediately after discharge is of minor value.

Estcourt House.

This institution is described as a home for the aged blind and for children who are crippled. According to the Medical Officer, Dr. F. Lucas Benham, it is becoming common for old people to apply for admission when their health is declining. This tendency is liable to give the institution the character of an infirmary, whereas it is intended to be a home where blind old people whose health and strength are unimpaired, may enjoy the remainder of their lives.

Three of the old people died during the year. One old man and two old women were admitted during the year. Of the three children admitted, one was a mentally defective girl and one was a boy with arrested growth. Three of the children were suffering from tuberculous disease of the spine and apparently the same number were suffering from *morbus coxæ*. The Medical Officer records "two or three" of these cases. It is surprising that there should be any doubt concerning the number of patients suffering from hip disease.

The *Venereal Diseases Act, 1918*, of New South Wales will come into operation on December 1, 1920.

Correspondence.

ANÆSTHETICS ADMINISTERED BY DENTISTS.

Sir: May I be permitted to refer to the letter of Dr. C. E. Corlette in your issue of November 13.

I have received from Messrs. Sly & Russell, Solicitors, the following letter, which speaks for itself.

Yours, etc.,
STEWART ZIELE, D.D.S.

"Craignish,"
185 Macquarie Street, Sydney,
November 18, 1920.

Sydney.
November 18, 1920.

Dr. W. Stewart Ziele,
"Craignish,"
Macquarie Street,
City.

Dear Sir: At your request we have made enquiries as to the case of administration of ethyl-chloride mentioned by Dr. C. E. Corlette in his letter to *The Medical Journal of Australia* of the 4th November, 1920.

We find on enquiry at the Coroner's Office that as the case took place before 1913 they have no record there which would have allowed Dr. Corlette's question to be answered if he had not been able to give the name of the deceased unless they had examined the papers in connexion with every inquest which had happened, which, of course, would be practically impossible.

The Coroner's Office referred us to the Department of Justice for further details, and we have inspected the depositions in the case and find that the anæsthetic ethyl-chloride was administered as Dr. Corlette states in the rooms of the Federal Dental Company, 12A Oxford Street, Sydney, on 2nd February, 1905. We further ascertained that the anæsthetic was not in fact administered by a registered dentist, but by a gentleman who described himself as a dentist, but as not registered in this State.

The case stated by Dr. Corlette is not, therefore, a case of administration of an anæsthetic by a registered dentist.

If Dr. Corlette had pursued his inquiries further he would have ascertained this fact.

Yours truly,
SLY & RUSSELL.

Proceedings of the Australian Medical Boards.

QUEENSLAND.

The undermentioned have been registered, under the provisions of *The Medical Act of 1867*, as duly qualified medical practitioners:—

Brandis, George Hayes, M.B., B.S. (Univ. Melb.), 1918, Rosemount Hospital.
Cook, Cecil Evelyn, M.B., Ch.M. (Univ. Syd.), 1920, Barcaldine.
Leckie, Thomson, M.B., B.S. (Univ. Melb.), 1918, Enoggera.
Morgan, Frederick Grantley, M.B., B.S. (Univ. Melb.), 1916, Mackay.
Spence, Lockhart James, M.B., Ch.B. (Univ. Edin.), 1914, Brisbane.
Sutherland, Charles, M.B., B.S. (Univ. Melb.), 1920, Brisbane.
Trumpy, David Ernest, M.B., B.S. (Univ. Melb.), 1917, Ipswich Hospital.
Randall, William Henry Norman, M.B., Ch.M. (Univ. Syd.), 1918, South Brisbane.

VICTORIA.

The undermentioned have been registered under the provisions of Part I. of the *Medical Act, 1915*, as duly qualified medical practitioners:—

Harold Thornton Bourne, Esq., M.B., Sydney, 1911, Belgrave.
Clifford Ellingworth, Esq., M.B. *et* Ch.B., Melb., 1920, Bank Street, Box Hill.

The names of the undermentioned deceased medical practitioners have been removed from the Register:—

Richard Kingston Bird.
Henry Richard Hurry.

SOUTH AUSTRALIA.

The undermentioned have been registered, under the provisions of the *Medical Act, 1880*, as duly qualified medical practitioners:—

Ponsford, Frank William Augustus, M.B., B.S., Melbourne, 1908.
Mathews, Norman Reginald, M.B., B.S., Melbourne, 1916.
Robertson, Duncan Glenerochie, M.B., Ch.B., Edin., 1909, M.D., Edin., 1912; D.P.H., R.C.S. and P., Eng., 1911.
Monckton, Henry Holland, L.S.A., London, 1897.
Macky, Stewart, M.B., B.S., Melbourne, 1914.
Reid, Jeanie Lawson, M.B., B.S., Melbourne, 1920.

The following additional diploma has been registered:—

Christina Love Krakowsky (*née* Goode), M.B., B.S., Melbourne, D.P.H., R.C.S. and P., Eng., 1913.

Books Received.

ELEMENTS OF PRACTICAL MEDICINE, by Alfred H. Carter, M.D., M.Sc., Revised by Alexander G. Gibson, M.A., D.M., F.R.C.P.; Eleventh Edition; 1920. London: H. K. Lewis & Company, Limited; Crown 8vo., pp. 695. Price, 16s. net.

INDEX TO PRACTICAL NURSING, by J. Basil Cook, M.D., D.P.H.; Second Edition; 1920. London: Baillière, Tindall & Cox; Crown 8vo., pp. 170. Price, 6s.

SURGICAL NURSING AND TECHNIQUE: A Book for Nurses, Dressers, House Surgeons, etc., by Charles P. Childe, B.A., F.R.C.S.; Third Edition; 1920. London: Baillière, Tindall & Cox; Crown 8vo., pp. 237, with 98 illustrations. Price, 6s. net.

HOW TO KEEP FIT: Two Lectures to the Boys of the R.A.N.B., Geelong, by F. J. Newman, M.B.; 1920. Sydney: Angus & Robertson, Ltd.; pocket size, pp. 48. Price, 1s. 6d.

MATERNITAS: A Book Concerning the Care of the Prospective Mother and Her Child, by Charles E. Paddock, M.D.; 1920. Chicago: Lloyd J. Head & Company, Melbourne: Stirling & Company; Crown 8vo., pp. 210, with illustrations. Price, $1.75.

PATHOGENIC MICRO-ORGANISMS: A Text-Book of Microbiology for Physicians and Students of Medicine, by Ward J. MacNeal, Ph.D., M.D. (based on Williams's Bacteriology); Second Edition; Revised and Enlarged; 1920. Philadelphia: P. Blakiston's Son & Company; Crown 8vo., pp. 488, with 221 illustrations.

Medical Appointments.

From August 24 and September 30, 1920, respectively the appointments of Dr. C. M. Samson (B.M.A.) and Dr. L. W. Nott (B.M.A.) as Quarantine Officers, have been cancelled.

It is announced that Dr. A. J. McShane, Dr. F. G. Morgan (B.M.A.) and Dr. E. H. White (B.M.A.) have been appointed Quarantine Officers.

Under the provisions of *The Aborigines Act, 1905*, Dr. T. Wilson (B.M.A.) has been appointed Resident Magistrate at Port Hedland, Western Australia.

Dr. W. C. Malone has been appointed Medical Officer for six months on probation to the Medical Branch of the Department of Education of New South Wales.

During the absence of Dr. E. H. Embley (B.M.A.) on leave, Dr. J. V. Guest (B.M.A.) has been appointed Certifying Medical Practitioner for the purposes of the *Factories and Shops Act, 1912*, of Victoria.

Medical Appointments Vacant, etc.

For announcements of medical appointments vacant, assistants, locum tenentes sought, etc., see "Advertiser," page xxvii.

The University of Melbourne: Stewart Lecturer in Surgery.

Commonwealth Public Service, Quarantine Branch: Assistant Bacteriologist.

Sydney Hospital: Honorary Physician.

Royal Alexandra Hospital for Children, Sydney: (*a*) Honorary Assistant Physician. (*b*) Honorary Assistant Radiographer.

Broken Hill and District Hospital: Senior and Two Junior Resident Medical Officers.

Medical Appointments.

IMPORTANT NOTICE.

Medical practitioners are requested not to apply for any appointment referred to in the following table, without having first communicated with the Honorary Secretary of the Branch named in the first column, or with the Medical Secretary of the British Medical Association, 429 Strand, London, W.C..

Branch.	APPOINTMENTS.
NEW SOUTH WALES. (Hon. Sec., 30-34 Elizabeth Street, Sydney.)	Australian Natives' Association. Ashfield and District Friendly Societies' Dispensary. Balmain United Friendly Societies' Dispensary. Friendly Society Lodges at Casino. Leichhardt and Petersham Dispensary. Manchester Unity Oddfellows' Medical Institute, Elizabeth Street, Sydney. Marrickville United Friendly Societies' Dispensary. North Sydney United Friendly Societies. People's Prudential Benefit Society. Phœnix Mutual Provident Society.
VICTORIA. (Hon Sec., Medical Society Hall, East Melbourne.)	All Institutes or Medical Dispensaries. Manchester Unity Independent Order of Oddfellows. Ancient Order of Foresters. Hibernian Australian Catholic Benefit Society. Grand United Order of Free Gardeners. Sons of Temperance. Order of St. Andrew. Australian Prudential Association Proprietary, Limited. Mutual National Provident Club. National Provident Association.
QUEENSLAND. (Hon. Sec., B.M.A. Building, Adelaide Street, Brisbane.)	Australian Natives' Association. Brisbane United Friendly Society Institute. Stannary Hills Hospital.
SOUTH AUSTRALIA. (Hon. Sec., 3 North Terrace, Adelaide.)	Contract Practice Appointments at Renmark. Contract Practice Appointments in South Australia.
WESTERN AUSTRALIA. (Hon. Sec., 6 Bank of New South Wales Chambers, St. George's Terrace, Perth.)	All Contract Practice Appointments in Western Australia.
NEW ZEALAND: WELLINGTON DIVISION. (Hon. Sec., Wellington.)	Friendly Society Lodges, Wellington, New Zealand.

Diary for the Month.

Nov. 30.—Vic. Branch, B.M.A.; ballot papers returned to Victorian Branch for election of office-bearers of Branch.
Dec. 1.—Vic. Branch, B.M.A.; Annual General Meeting, election of office-bearers.
Dec. 7.—N.S.W. Branch, B.M.A., Ethics Committee.
Dec. 9.—Q. Branch, B.M.A., Council.
Dec. 10.—Q. Branch, B.M.A., Annual General Meeting.
Dec. 10.—N.S.W. Branch, B.M.A..
Dec. 10.—S. Aust. Branch, B.M.A., Council.
Dec. 14.—Tas. Branch, B.M.A..
Dec. 14.—N.S.W. Branch, B.M.A.; Executive and Finance Committee.
Dec. 15.—W. Aust. Branch, B.M.A..
Dec. 16.—Vic. Branch, B.M.A., Council.
Dec. 16.—Western Suburbs Med. Assoc., Annual (N.S.W.).
Dec. 21.—N.S.W. Branch, B.M.A.; Medical Politics Committee; Organization and Science Committee.

EDITORIAL NOTICES.

Manuscripts forwarded to the office of this journal cannot under any circumstances be returned.

Original articles forwarded for publication are understood to be offered to *The Medical Journal of Australia* alone, unless the contrary be stated.

All communications should be addressed to "The Editor," *The Medical Journal of Australia*, B.M.A. Building, 30-34 Elizabeth Street, Sydney. (Telephone: B. 4635.)